CHEMICAL & METALLURGICAL ENGINEERING

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Cover picture shows great battery of filter presses in the porcelain plant of the Westinghouse Electric & Manufacturing Co. at Derry, Pa. Other illustrations appear in the pictured flow sheet on pages 421–24 of this issue, which describes the wet process for making porcelain. [*Cover space released for editorial use by Patterson Foundry & Machine Co.*]

Pennies for Your Thoughts

Engineers in Process Industries are in an unusually favorable position to pick up novel and useful operating ideas that are worth money to others. Such ideas, expressed in short articles, are worth money to *Chem. & Met.* and worth money to you if you send them in. These articles, if accepted for publication, are paid for at higher than normal space rates, with a minimum of $5 for even the shortest item. How you made an emergency repair; how you simplified an operating problem; a useful chart or method of computation; an unusual safety measure — all these are acceptable types of material. Novelty and practicability are essential; photographs or sketches desirable. But fancy writing and finished drawings are *not* required. Let's hear from you!

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JULY, 1939

S. D. KIRKPATRICK, *Editor*

Simplifying Management's Job

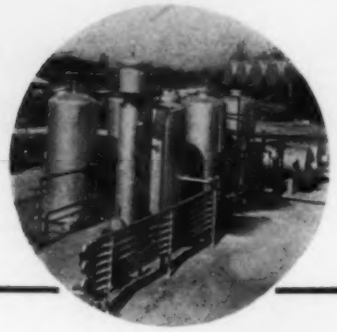
YEARS AGO when the Department of Commerce was under Secretary Hoover, we heard much of its Division of Simplified Practice. It was concerned with the elimination of needless varieties of sizes, shapes and grades of everything from nuts and bolts to baby carriages. Its work was responsible for tremendous savings in materials. Lately, however, there has come a growing realization that the basic principles of simplification and standardization need not be limited to products and materials—that, in essence, sound standards of policy and procedure are the best possible tools for the managerial control of industry.

Howard Coonley, able president of the National Association of Manufacturers, recently made the statement that during his long experience in company operations he had found that the use of effective standards was one of the most reliable ways in which an executive can reduce the mounting pressure on his time and energy. "Standardized products, standardized specifications for materials, standard processes, standard operating routines—all help to relieve this pressure on executives up and down the line from foreman to president."

This is accomplished by cutting down on the number of decisions that have to be made on matters of operating routine, thus giving more time for matters of policy. Misunderstandings with customers and minor controversies over plant operations can be avoided if suitable standards are known and observed. In effect, a set of company standards not only protects the top management from unnecessary detail and interference, but also makes it easier for the man on the job to accomplish exactly what is expected of him.

Various companies in the chemical engineering field are making good use of standard costs and performance requirements as a means of controlling their plant operations. This is especially effective where a company operates a number of plants that are widely separated geographically but concerned with the same type of processes. What W. I. McNeill of Colgate-Palmolive-Peet has recently reported about cost and operating standards in the soap industry is an excellent example of procedures that other chemical engineers might well apply in their own plants. Standardization, if the prescription is properly written, is good medicine for all industries.

Engineers blazed the trail for standardization. In fact, the American Standards Association had its origin in the joint effort of five of the engineering societies and for the first ten years of its existence was known as the American Engineering Standards Committee. Then as its work broadened, it extended its influence through trade associations and governmental and industrial organizations. Now it has become increasingly apparent that the field of management offers an even greater opportunity for advancing a national standardization program. To give executive support and direction to this movement, President Prentice of A.S.A. has appointed an exceptionally strong Advisory Committee under the chairmanship of Mr. Coonley and including a dozen of the outstanding leaders of American industry. Theirs is an opportunity to carry forward a program, initiated by engineers and destined to make easier the task of management in carrying the increasing burdens of modern industry.



From an

TOO MANY CHEMICAL ENGINEERS?

EACH YEAR graduation of hundreds of young men with titles of bachelor of science in chemical engineering regularly raises this old question. And it can be answered rightly both with a "yes" and with a "no." This subject is of importance to industry as well as to the young men and to the professors who train them.

In several educational institutions the students seeking training in chemical engineering are more numerous than those pursuing any other single engineering curriculum. In many other institutions the number is greater than any group except mechanical engineering. This situation is somewhat unfortunate if all these students really expect to become full-fledged chemical engineers during their money-earning days after college.

American enterprise is not yet keyed up to absorb such great numbers promptly and to maintain them in full chemical engineering status. However, there will be no harm, perhaps even much good, if many of these young men with this valuable training take up other sorts of business activity in the chemical process industries.

It will be a good thing if industry and the college faculty concerned can cooperate a bit more closely. One of their first joint jobs is to make it evident to youngsters that this double-barreled name "chemical engineering" does not have merely the twin glamor of the magic of chemistry and the boy-satisfying prospect of being an engineer. There are also involved many arduous hours of work in class room and laboratory, probably more than are involved in any other single curriculum on the average campus. There must then follow also the practical industrial apprenticeship *in overalls*, before the graduate even begins to be a chemical engineer in fact.

All connected with chemical engineering enterprise have a duty in this matter. All of us are frequently asked by young men whether or not they should take up chemical engineering, and how to proceed with it. The inspiration of a professional career should not be denied. But the young inquirers should be warned that there is no easy road, nor even necessarily a good job in true chemical engineering at the end of their hard work. The training will be worth while nonethe-less, provided they are prepared to apply it in some way peculiarly suited to their own personalities and business opportunities. A clearer understanding of these facts at the outset will save many disappointments, and probably some misfits.

OLD INDUSTRY—NEW TRICKS

GLASS may be one of the oldest of process industries, but there has been ample evidence in recent years that it has young ideas. The answer is not far to seek; research and yet more research, an eternal looking for (and finding) new products.

At the Chicago Fair in 1893 there was no end to the amazement of those people of a less blasé era at the spun glass fabrics there displayed—but nobody was so credulous as to expect spun glass to become more than a curiosity. Yet, for two years now, mass-produced glass fibers, woven into an endless variety of decorative and industrial fabrics and electrical insulations, have been a very active competitor, indeed, of the older fibers. Some day, it is not too much to expect, spun glass clothing will have conquered its tendency to itch the human skin, and such clothing will have become commonplace.

In the short time they have been available, printed-fused colors on glass, glass brick, safety glass, have become almost too common to mention. A new glass centrifugal pump, just announced, which appears to have overcome the difficulties of its predecessors, will soon be a novelty no longer.

Perhaps Corning Glass Works was wise, therefore, in predicting that a full two years must pass before it will be possible to tell the uses to be made of the new low-expansion glass which is described on another page, in our news section. Blown or molded like ordinary glass, then heat treated and leached with acid to remove the bulk of the non-siliceous materials present, finally revitrified to remove the porous structure left by the leaching, the new product is clear, is about 96 per cent pure silica, has a thermal expansion a quarter that of the best previous low expansion glass, and only 40 per cent more than fused silica. Yet it is said that mass production methods can be used in making the new ware. Without too wild a speculation, we can hazard a guess that chemical equipment is going to benefit materially once the new product is on the market.

Editorial Viewpoint

USE AND VALUE OF HISTORY

A FAMOUS AUTOMOBILE MANUFACTURER once said, at least according to the reports, that the study of history was a waste of time. He had found no practical *use* for history, hence he thought it had no *value* to him. Yet we know that in later years this same manufacturer has found some of his greatest personal pleasure and satisfaction in the study and collection of the buildings, tools and equipment of early American industry. After all, what is that, if it is not value? In the words of the eminent engineering historian, Henry C. Dickinson, "History helps us to live more understanding lives, with greater satisfaction to ourselves and more toleration toward others."

And history does have its uses as well as its values. Witness the events that occurred in Rhode Island on June 23, when that state joined the local community and the Rumford Chemical Works in celebrating "Baking Powder's 80th Birthday." Here was an 85-year-old chemical company that not only capitalized on the name, personality and remarkable achievements of that great 18th century scientist, Count Rumford, but also used its own history to improve and strengthen its relations with employees, customers and an interested public. Executives of other chemical companies that have long hidden their historical lights under forgotten bushels, may profit by reading the Public Relations article in this issue written by our old friend and Rumford's new president, Albert E. Marshall.

HOW'S YOUR WEIGHT?

OFTEN FAR TOO MUCH reliance is placed in the accuracy of track and truck scales. Recent field studies of the Bureau of Standards disclose that nearly four out of five of the vehicle scales they tested were significantly inaccurate, that is, more in error than proper tolerance would allow. The average error is in fact about six and one-half times the normal tolerance for such equipment.

This may be of importance to some industries. It may mean significant losses in purchases of coal and other materials or it may be the basis of costly errors in stock-pile calculations. It may even affect the proportioning of raw-material charges for process equipment. The remedy is obvious to any chemical engineer who compares the possible savings with the slight cost of having the scale calibrated.

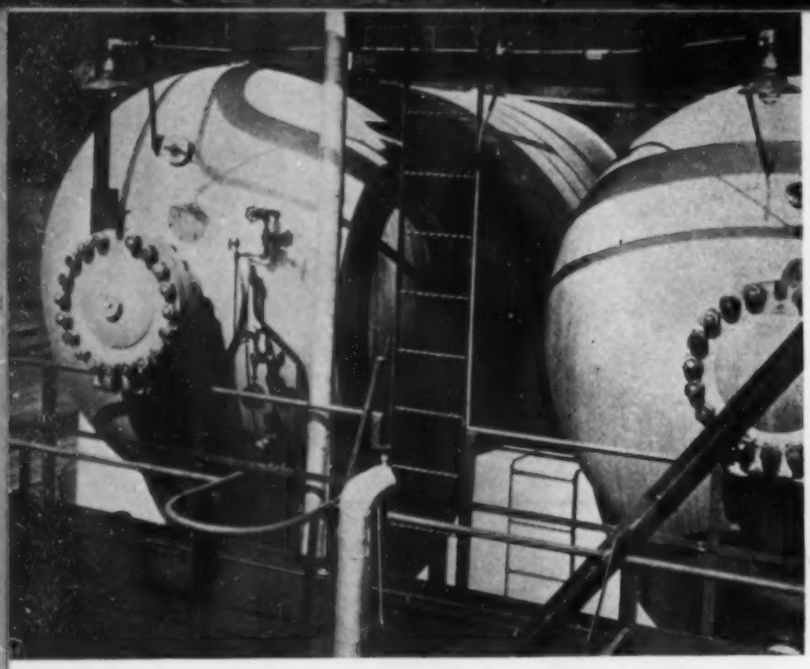
WORKING FOR NOTHING?

THIS SUMMER it has been harder than usual to get temporary jobs in industry. Some chemical engineering sophomores and juniors, who are still able to live off of fairly prosperous dads, have offered to work just for the experience. They can't understand why their generous propositions are turned down by short-sighted industrialists.

Three of last year's graduates from Newark College of Engineering joined with an unemployed chemical engineer from Cooper Union to offer their services to industry as "technical counsel" in return for the mere chance of picking up some worthwhile experience. And, despite considerable publicity in metropolitan newspapers, their services still go begging. They wonder why.

The reasons are not hard to find. One is a wages and hours law that makes it illegal to work for anything less than minimum wages or for more than a definite maximum of hours. Social security, unemployment insurance and old-age pensions are all very nice and it's hard to understand how we ever got along without them. Yet all together they add a lot more red tape and grief—so much so that several companies which formerly took on a few boys each summer, have put out the sign "No Temporary Help Wanted This Summer."

Of course, it is possible to work for nothing if you really want to. Last January, for example, a couple of young chemical engineers of our acquaintance decided to ask their boss for a year's leave of absence without pay. In the past five months they have covered most of South America from the nitrate pampas of Chile to the tin mines of Bolivia and the oilfields of Venezuela. Last week, while waiting for a freighter to carry them to Europe and Asia for seven months more of fun and experience, they dropped into our offices to sell us some articles—for almost nothing! The first will appear next month and when you've read it, we suspect that you will join us in envying these world travelers in their year of "working for nothing."



Liquid propane, which acts as both a selective solvent and a self refrigerant, is stored in these tanks

Playing With

New chemical raw materials of able from Pennsylvania petroleum an improved technique in physical

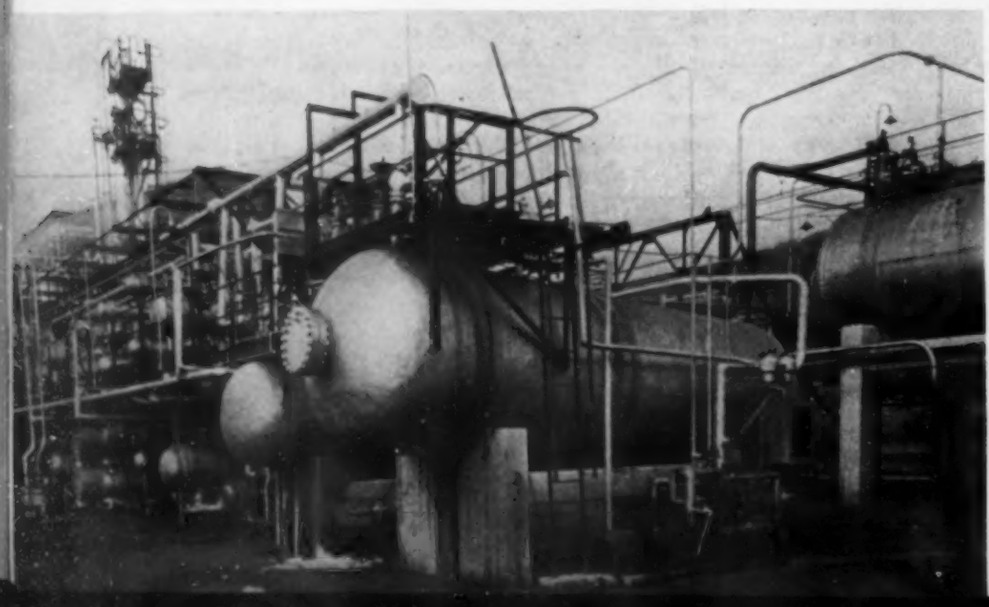
S. D. KIRKPATRICK, *Editor,*

IN THE RAPIDLY GROWING organic chemical industry based on the hydrocarbons from petroleum, all too little attention has been given to one of the oldest and purest of all sources of the paraffines—Pennsylvania crude oil. It has long been valued at a premium over other crudes because of the high quality of the lubricants made from it. But, by the same token, since it is so low in the unsaturated hydrocarbons most chemists have regarded it as of questionable value as raw material for chemical processing. Except for methane, ethane, propane and butane, they have concentrated their attention largely on the olefines obtained from the gases of various cracking processes. Lately, however, and largely growing out of the work at Pennsylvania State College by Fenske and his associates, some interesting developments on the higher paraffines are under way—notably at the Bradford, Pa. refinery of the Kendall Refining Co. These operations are resulting in several new products of unique properties which may prove of value to many chemical process industries. This article describes their preparation.

The first of these products consists of a series of high-boiling naphthas, distilled from Pennsylvania kerosene or gas oils. They cover, in general, the range from C_{10} to C_{20} and are available in sharply cut fractions boiling over a temperature range as narrow as 10 deg. C. Thus it is possible to obtain, for the first time in commercial quantities, these high boiling paraffines in relatively pure and concentrated form. Obviously their solvent properties are not nearly as high as the more aromatic naphthas made by hydrogenation or by solvent extraction of certain Californian oils. Their great advantage, however, lies in their extreme uniformity since they are made from a single source of crude oil that has long been famous for its remarkable stability.

The second series of new products being made by Kendall consists of dewaxed and deresined mineral oils of extremely high viscosity and high-viscosity resinous materials obtained from the operation of its new propane dewaxing and deresining plant. In producing high grade motor oils from Bradford cylinder stock having a viscosity of about 165 S.S.U. (Standard Saybolt Units) at 210 deg. F., this plant removes about 3 to 5 per cent of very heavy resins having a viscosity of 3,000 to 4,000 S.S.U. at 210 deg. Removal of this quantity of very viscous material (only about 0.5 to 0.9 per cent based on the crude) greatly facilitates the manufacture of lubricating oil and at the same time yields these interesting byproducts. Again, like the naphthas, these high-viscosity products are free from sulphur and are of extremely uniform composition and properties. They are being used on a considerable scale in compounding special rubber and plastic compositions. Other applications will doubtless develop as their unusual characteristics become better known.

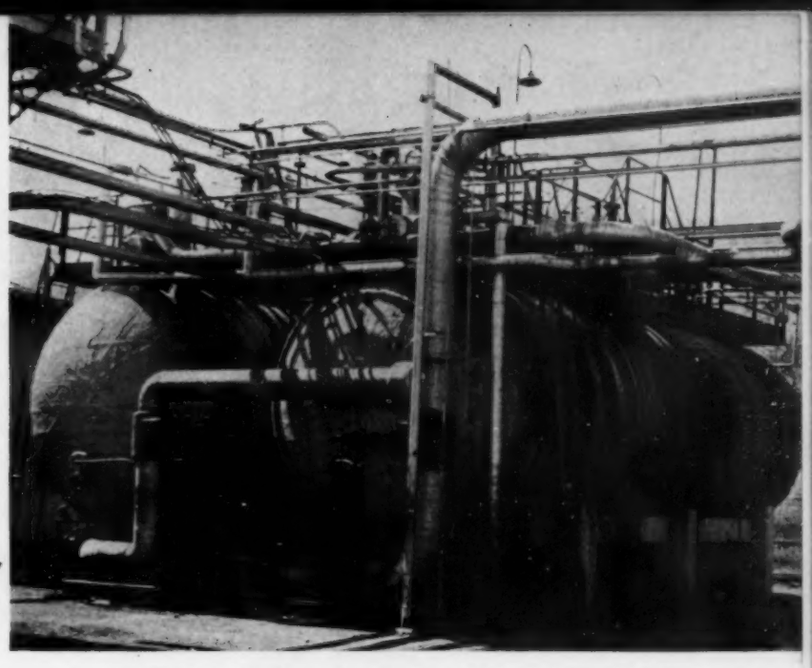
The super-fractionating equipment required for the production of the special naphthas cannot be described in detail at this time. W. B. McCluer, technical director at Kendall, and a former associate of Professor Fenske, was principally responsible for a chemical engineering design that duplicates on a commercial scale the distillation results obtained by Dr. Ralph W. Hufferd in his research laboratory when operating a special fractionating column equivalent to 32 theoretical plates. One of the latter's distillation curves for a typical Bradford gas oil is shown in Fig. 1. Close temperature control in the commercial unit is made possible by the use of Dowtherm as an indirect heating medium. Extremely precise control of the reflux ratio is effected through



Heat exchangers, deresining drum (foreground), and storage tanks in Kendall's propane dewaxing plant at Bradford

the Paraffines

unique properties have become available as one of its refiners develops and chemical processing of oils.



Oil which has been deresined and dewaxed is stored in these tanks prior to the final filtration step

automatic control and recording instruments.

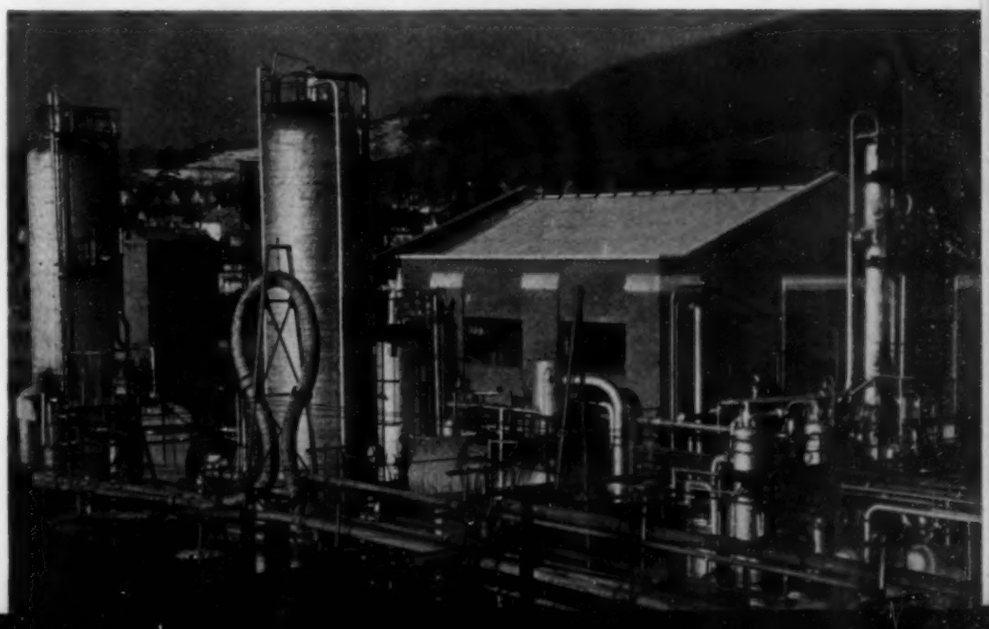
Just where these higher boiling paraffines are to fit into the requirements of chemical industry is not immediately apparent. To continue to burn them as fuel, however, seems an economic crime. In Germany some of the equivalent paraffines obtained by the hydrogenation of coal are being oxidized to yield mixtures of alcohols, ketones, aldehydes and even fatty acids. It is reported that more than a quarter of the soap used in Germany today is made from these synthetic fatty acids. Here in the United States, the work of Professor Henry B. Hass and his associates at Purdue University on the nitration of the paraffines may prove an entering wedge for much wider application in chemical industry. It is reported that the Commercial Solvents Corp. will have a semi-commercial plant in operation to produce these nitro-paraffines within the present year. That work, at the beginning at least, will probably be concerned with lighter hydrocarbons than those in the Kendall distillates although applications for products of higher molecular weight may logically be expected.

The story behind the story of the work of Fenske and others on Pennsylvania petroleum is an interesting one. Up to a few years ago, the Pennsylvania refiners were sitting pretty. The consuming public had very generally recognized the higher quality of Pennsylvania-grade lubricants and were willing to pay a reasonable premium for such products. For a long time the rest of the industry sat back and enviously regarded this as a sort of God-given monopoly. Then about ten years ago, some of the petroleum technologists decided to do something about it. Working with inferior—or at least much less expensive crudes—they developed a number of new refining processes that had the effect of improving the character of their lubricating oils, in many cases closely approaching the conventional Pennsylvania grade. The Pennsylvania refiner, sometimes paying twice as much for his crude oil, began to feel this competition. Added to that was a second important change as the automobile industry gradually trended toward lighter motor oils that would stand up better under the higher temperatures and pressures of the modern engine.

So it became apparent that if the Pennsylvania refiners were to compete successfully with improved oils from cheaper crudes they either had to be prepared to offer equivalent quality at competitive prices or they had to get busy and deliver still higher quality to justify a premium price. The latter course is the one that appealed to the management of Kendall.

It is generally known that Pennsylvanian oils lend themselves more readily than most others to the application of some of the newer refining methods. Because of their inherent quality, there is less decrease in yield. To meet the present-day requirements for lower viscosity motor oils, with a minimum loss in production, it is only necessary to remove a relatively small amount of the very viscous material. These considerations led the Kendall Refining Co. in 1936 to install a propane dewaxing and deresining plant. Its operations have been described by McCluer, Dickinson and Forrest in *Oil & Gas Journal* for March 31, 1938, and more recently in *National Petroleum News* for October, 1938.

Processing petroleum with one of its own constituents, propane (boiling point —44.5 deg. C.) is interesting and ingenious because it takes advantage of propane's remarkable properties both as a selective solvent and as a self-refrigerant. At normal temperatures propane is an excellent solvent for petroleum, but when the temperature is raised to around 120 deg. F.,



Insulated vertical chilling towers at left and building housing continuous rotary drum filters in background

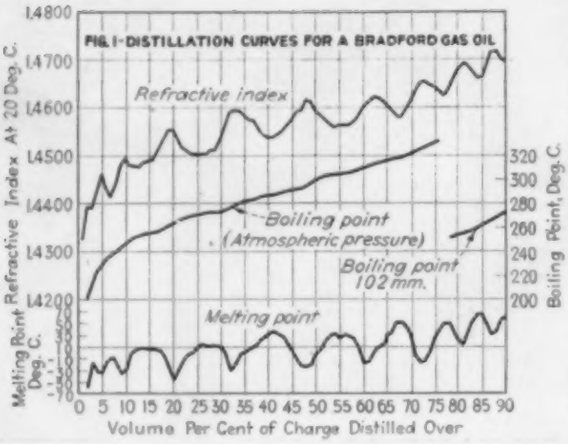


FIG. 1-DISTILLATION CURVES FOR A BRADFORD GAS OIL
Refractive Index
Boiling point (Atmospheric pressure)
Boiling point 102 mm.
Melting point
Refractive Index At 20 Deg. C.
Melting Point, Deg. C.
Boiling Point, Deg. C.
Volume Per Cent of Charge Distilled Over

the asphaltic or non-paraffinic components of the oil are precipitated. On further heating there is a separation of color bodies and carbon-forming materials until at 212.2 deg. F., which is the critical temperature of propane, all viscous constituents have been thrown out of the solution.

On the other hand as the temperature is lowered from normal, the wax is crystallized from the solution and can readily be removed by continuous filtration because of the low viscosity of the propane solution.

Furthermore, since propane is itself a very satisfactory refrigerant, there is no necessity for outside cooling and hence there is a resulting saving in heat exchange equipment. A final advantage is that propane is relatively cheap, generally available in most refineries, can be easily handled and stored in liquid form.

A simplified flow diagram of the propane dewaxing and fractionating plant as installed at Bradford by the M. W. Kellogg Co., is shown in Fig. 2. The flow of materials through the plant is as follows: Propane from the storage tank is mixed with the charging stock in the warm solution tank and is pumped then to the chillers where it is cooled by the direct evaporation of propane from the solution. This propane is drawn to the compressor and returned to the storage tank. In the meantime, cold propane which has been chilled by exchange with the dewaxed solution from the filters is added to the chiller to make up for the volume that had been vaporized and to maintain a constant oil-propane ratio in the chillers.

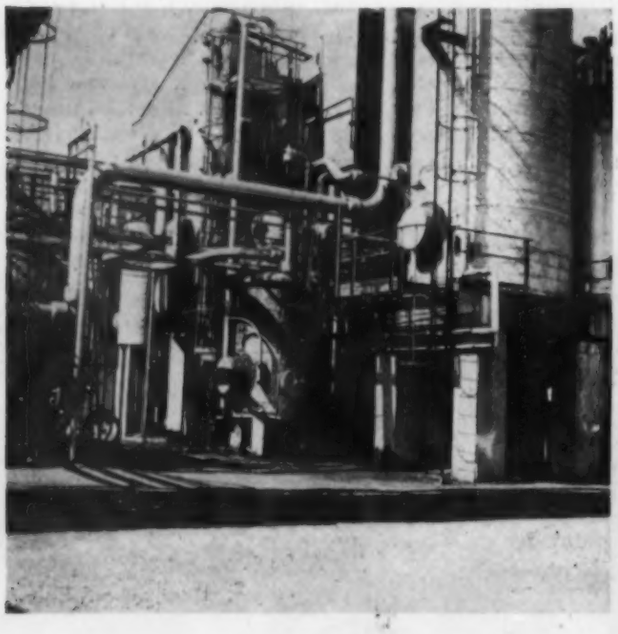
The chilled solution is transferred to the filter-feed tank and from there pumped continuously to the filters. These are Oliver continuous pressure filters of the rotary drum type. Being completely inclosed, they can operate under a positive propane gas pressure differential maintained at approximately 5 lb. per sq. in. by means of the blow-gas compressor. The filter drum is partially submerged in the chilled solution and partially exposed to the propane gas. The wax cake forms continuously on the drum surface, dries and is scraped off into the screw conveyor in the filter shell. It is then pumped to the petrolatum depropanizing still.

The dewaxed solution, after passing through the heat exchanger, enters a series of four propane fractionating settlers. From these a completely deresined and dewaxed oil is pumped to another depropanizing still. After the propane has been completely removed, the oil is ready for clay treatment through percolating filters.

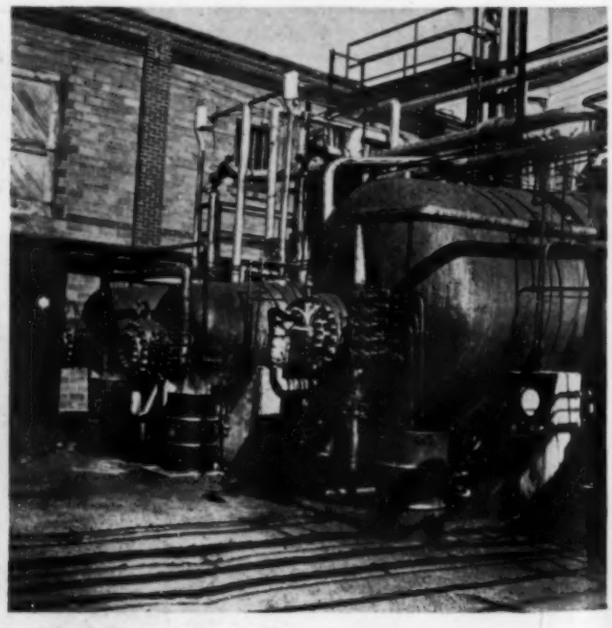
Likewise the resin fractions settling out in the last three settlers are pumped separately to their respective depropanizing stills. These return the propane to the compressor for the propane storage tanks and yield as products the 400, 800, and 2,000 viscosity oils whose properties are shown in Table I.

Operating data for the Bradford plant during the first six months of 1938 (as reported by McCluer, Dickinson and Forrest, *loc. cit.*) show the average daily capacity of the unit was 1,053 bbl. Although a variety of different stocks were charged, sometimes for relatively short periods, the throughput was kept remarkably constant. The dewaxing and deresining yields for the first six months of 1938 are shown in Table II. Typical operat-

At left is a warm solution tank from which oil flows to the vertical propane chiller at right



In these deresining drums on the depropanizing stills, high-viscosity products are separated



ing cost data for propane processing of Pennsylvania cylinder oil are shown in Table III. Most of the yield and operating cost savings result from improved operation on residual stocks. However, the consolidation of distillate and residual dewaxing plants into a single unit results in appreciable savings in labor, maintenance and fixed costs. The precipitation of the resins and high-viscosity oils increases the yields through the percolating filters and proportionately decreases the decolorizing costs.

Propane processing has been applied in many other petroleum refineries throughout the world, but the unique feature of the Bradford plant is the provision for converting these resinous byproducts into high viscosity specialties available for further chemical and physical processing. Because of their high purity, uniform composition and unique properties, they should find an increasing market in the chemical and process industries.

Table I—Physical Properties of High-Viscosity Products Obtained from Pennsylvania Petroleum

Specific Gravity (Deg. A.P.I.)	Flash-Point (Deg. F.)	Fire-Point (Deg. F.)	Viscosity at 100 Deg. F.	Viscosity at 210 Deg. F.	Pour-Point (Deg. F.)	Penetration	Melting Point (Deg. F.)
High Viscosity Oil No. 1							
22.9	585	670	12,280	396	15	.....	.....
22.4	605	690	.....	440	20	.....	.....
22.9	595	680	.....	381	10	.....	.....
High Viscosity Oil No. 2							
21.4	620	720	32,050	818	25	.....	.....
20.3	615	700	.....	903	30	.....	.....
21.3	620	715	.....	675.5	25	.....	.....
High Viscosity Oil No. 3							
18.4	635	725	.....	1,894	55	.....	.....
18.7	635	730	.....	1,824	60	.....	.....
Resin							
16.7	615	720	.....	2,910	60	.....	.....
Petrolatum							
.....	.....	.....	.....	127–136	.....	60 (77° & 100 g.)	126–133 (ASTM D127–30)
Modified Petrolatum							
20.3	540	620	.....	580	.....	26.5 (77° & 100 g.)	132.8 (ASTM D127–30)

Modified Resins

Type	Ball and Ring Softening Point (ASTM D36–26), Deg. F.	Penetration 100 g. wt. (ASTM D-5–25)	Solubility % in CCl_4
SR-2	107	142	99.96
3	115	101	99.96
4	131	59	99.96
5	218	23	99.20

Table II—Yields Obtained with Various Charging Stocks at the Bradford Refinery, January–June, 1938

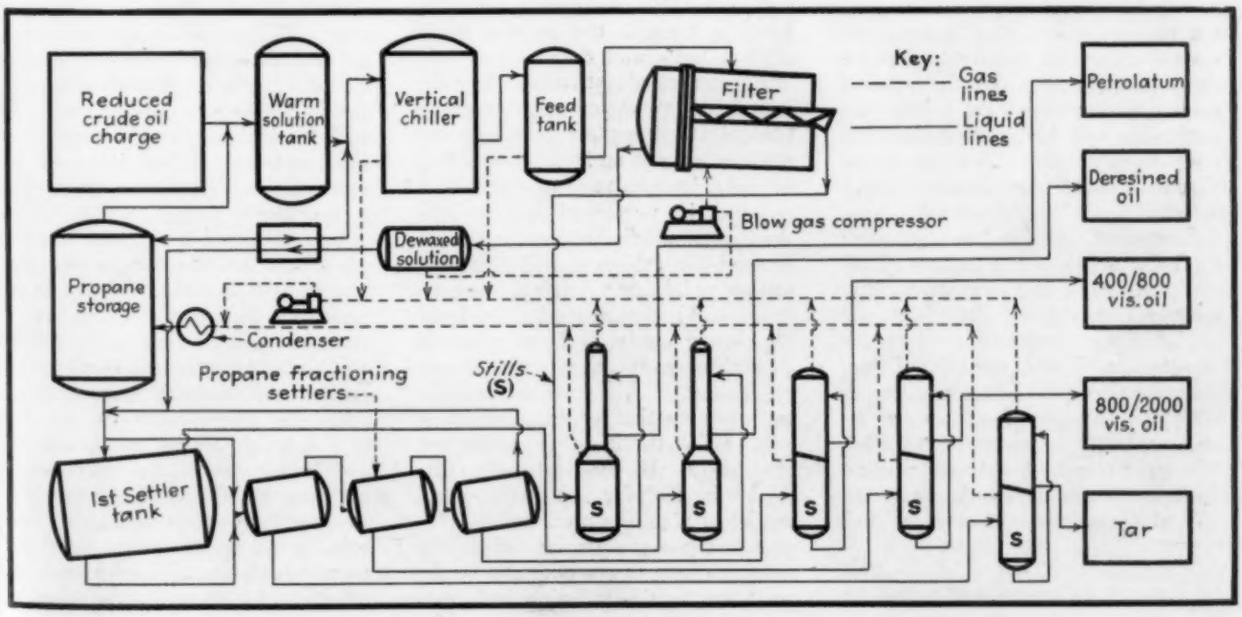
	Cylinder Stock — 165 Vis. at 210 deg. F. Zero Pour Point 125 Vis.	Zero Pour Point 150 Vis.	+20 Pour Point 150 Vis.	Heavy Neutral Zero Pour Point	Light Neutral Zero Pour Point
Stock charged, bbl.	12,676	45,837	59,872	14,864	37,727
Dewaxed oil, bbl.	10,717	39,180	54,218	12,558	31,089
Per cent	84.6	85.5	90.5	84.5	82.4
Dewaxed and deresined oil, bbl.	8,797	36,647	51,152	.....	.....
Per cent	69.4	80.0	85.4	.....	.....
Petrolatum or wax, bbl.	1,959	6,657	5,654	2,306	6,638
Per cent	15.4	14.5	9.5	15.5	17.6
Resins, bbl.	1,920	2,533	3,066	.....	.....
Per cent	15.2	5.5	5.1	.....	.....

Table III—Operating Cost of Dewaxing and Deresining

(Charge Capacity, 1,000 bbl. per day).

	Operating Cost: Dollars Per Day
Steam at 25c./M lb.	$96.00
Electricity at 0.6c./kw.-hr.	57.00
Water at 1c./M gal.	22.50
Propane at 6c./gal.	20.00
Labor at 85c. per man hr.	81.00
Maintenance at 3%	70.00
	$346.50
Cost, c./bbl., charge (Based on Penn. cylinder oil)	34.7

Fig. 2—Flowsheet of the Kellogg process of dewaxing and deresining lubricating oils with the use of propane as adapted for use at the Bradford (Pa.) plant of the Kendall Refining Co.



Selling to Industries

Whether we sell chemicals, raw materials, processing equipment or simply our personal qualities, all of us are salesmen. Invariably we run into difficulties in selling. Mr. Hooker lends a few suggestions that may help us over some of the obstacles.

A. H. HOOKER, JR.
Western Sales Manager
Hooker Electrochemical Co.
Tacoma, Wash.

IT'S AN OLD American custom to resent advice. But you can't resent the kind of interesting albiet pointed remarks made by a man of such wide experience as A. H. Hooker, Jr.—especially when they concern a subject as vital as selling. The reason Mr. Hooker's remarks apply particularly to us as chemical engineers is that he thinks the same way we do because he, too, is a technical man. Before obtaining his A.B. in chemistry at Cornell he worked in most of the technical departments of the Hooker Electrochemical Co. Likewise before graduation, he was called away to war as a member of the Chemical Warfare Service and emerged a 1st Lieutenant and Chief Gas Officer. Now he is Major Hooker, C.W.S. Reserve.

Since the war Mr. Hooker has served the Hooker company in many capacities. He chose to advance along the lines of sales, research and development and this kind of work carried him first to all parts of the United States, then to many foreign countries on market surveys and finally back to the West Coast where he has served as Western Sales Manager for the past 11 years.

EVERYONE SELLS goods, labor or service. This discussion deals with industrial sales to manufacturers, dealers or consumers. They purchase materials for the profitable operation of their own business and profit is necessary if their business is to survive.

During the World War it took ten workers to supply one soldier, and ten soldiers in the rear to keep one combat soldier at the front. The industrial salesman, like the combat soldier, is the outlet for a large organization and his qualifications are equally important. Like the Army Commander, he must decide: What? Why? When? Where? How?

Successful selling takes creative thinking, which is the hardest of all work. It is a nervous strain, frequently discouraging and tiring. It is difficult to maintain good health due to travel and irregular living. Even the Federal Government recognizes the necessity for long and irregular hours in exempting outside salesmen from its hourly restrictions. Selling is an endless task continuing day after day, year after year, stopping for neither success nor failure.

Selling has its rewards. It has fascination and variety with very little routine. Business trips take the salesman to interesting and unusual places. He meets interesting and important people under pleasant and favorable conditions. He is well paid. He earns it, for his efforts provide the necessary outlets for his company's products. For him there is the satisfaction of difficult tasks well done.

A technical education and extensive industrial experience provide essential sales training. It may take ten years or more in an industry to obtain practical knowledge of its established policies, its personnel and its production methods. With such a background the salesman will find new selling points and develop improvements and new uses for his products. Continued studying is as essential in selling as in any other major profession.

"Send for that pipe salesman. I need his help on some production problems," the superintendent told his buyer. No pipe sale was involved, but when pipe was needed this salesman was in a preferred position. The salesman who can service his equipment and provide technical assistance has a real advantage. Increasing numbers of salesmen are being promoted from production departments.

The qualified buyer is considerate and courteous to responsible salesmen. He appreciates their efforts to supply a definite need, new ideas or equipment or materials to increase economies and profits. The buyer expects to give and receive fair treatment. He frequently sees more people than most of his own outside men. Through such important contacts he too is a salesman, building up good will for his company even when he buys nothing. From salesmen the buyer gets much information of value to his company.

You, as a salesman, must like people and be liked by them to effectively convey your message. Show your appreciation of the value of the buyer's time, as well as your own. Act responsible and dignified. Don't be tiresome, with lengthy preambles or memorized speeches. Respect the buyer's feelings, wishes and judgment. Follow his mood. Be interested in his interests, especially his business. Be careful not to bore him, or force him, or antagonize him. Avoid flattery, complaints and criticisms, and offensive stories or controversies, as

Based on an address before the Pacific Northwest Chemical Engineering Conference at the University of Washington, Seattle, May 13, 1939.

in politics or religion. Watch your manners and personal appearance.

Be friendly with all the customer's personnel. They can be helpful in unexpected ways. A friendly assistant will occasionally tip you off to something really worth while. When subordinates are promoted, they will remember your past courtesies.

"Thanks for calling. Come see us again. We might buy from you next year," said the mill manager. However, he granted the salesman's request for three minutes the following morning. With thorough belief in his proposition, the salesman worked practically all night correlating and writing out his arguments. The first thing the following morning he presented them briefly. The mill manager was impressed. "You win! This year I'll try getting half of my requirements from your company." It was a large contract, which has been renewed each year. Be brief and resourceful and properly time your presentation. Avoid haste, but do not overstay.

Value of a Personal Call

"Quote on a thousand tons of Y-Z compound for our immediate use." This wire brought answers from a group of producers—but the order went to a salesman who didn't quote at all. He went to this mill and demonstrated that the economical method for them was to buy the raw materials and make their own compound. He was of exceptional value through his knowledge of his own products and of the buyer's requirements.

"Don't take time seeing that company. They manufacture their own intermediates," advised the sales manager, but the salesman dropped in anyway and made friends. Shortly thereafter, due to a power shortage, this company was not able to produce the required intermediates, and the salesman got the largest order he had ever received. Don't overlook a prospect.

Respect your competition. Don't belittle it. Try to be better than it is. Knowing your competition and their products lessens the fear thereof. Avoid direct comparisons. Emphasize the advantages and exclusive features of your product. Study the sales methods and tactics of others. Sell as best you can, not as others do.

"Don't buy from him. He can't be trusted," a buyer was told about a salesman who had been his intimate friend for years. A buyer's loyalty to a competing salesman should be respected. He may sometime be equally loyal to you.

"Don't buy there. It's a family company," a salesman told a mill manager, who himself was training two sons to succeed him in the business inherited from his father and founded by his grandfather. Criticism wastes time and builds up a defense.

"You promised me that order!" The salesman was mad, and the buyer embarrassed, but circumstances had justified a reconsideration of his earlier decision. The salesman lost a friend and all further orders that would have gone to him. Be calm and control your temper. Don't be afraid to lose an order. You can't sell everyone.

"Your price is too high," is discouraging, but not final, and not always true. Point out the difference between price and value. Lower prices may indicate inferior quality, antiquated or bankrupt stocks, temporarily available in limited quantities. Products can not be sold continuously at a loss. A permanent, satisfactory source of supply is always desirable. Demonstrate the outstanding features of your own product, its simplicity, superior quality, better workmanship, longer life or greater resale value. Emphasize the advantages of your company's reputation, experience and special assistance in manufacturing or selling or advertising. The convenience and ease of continuing established deliveries and satisfactory sales and service may offset temporary lower prices from others.

Budget Your Time

Time is "money" with the salesman. Budget your hours to utilize your available time wisely, allowing for variations to meet special needs. Plan each trip through your territory carefully, completely and economically to provide for seasonal sales or contract expirations. Circumstances will govern the means of travel whether by ship, plane, train, bus, automobile, trolley, on horseback or on foot, or some combination thereof. Letters, wires and phone calls all serve a purpose, but there is no substitute for the personal sales call.

"Salesmen Interview Between 11 a.m. and Noon on Wednesday" need not apply to you. The buyer's wishes must be respected, but he will generally make exceptions for his friends or for important callers. The more successful salesmen devote normal office hours to contacting customers and prospects. They start early and get back late, and devote many of their evenings to "home work."

"He's a dirty crook—giving somebody else that order after all the meals I've bought him." Entertaining a buyer should not put him under obligation. Normally it is a courtesy, extending to the seller more time than is available during office hours.

Your sales cost is your salary plus your expenses. The comparison of this cost to your sales may well be the basis of your continued employment or promotion. Travel and stay where you can properly and conveniently meet your customers, keeping your expenses conservative, reasonable and fair.

How to Entertain

Entertaining requires tact and discretion. Extravagant entertaining is bad taste and often creates the impression of poor judgment or excessive profit. Intemperance is never justified. Balance each sales expense against the company's benefit derived.

The use of civic, social and club activities for sales purposes is overdone. They should be incidental for contacts and good will. Don't play "customer's golf." Play everything to win; but be gracious, win or lose. Don't depend on others for help. "Connections" and "pull" are insufficient in themselves. Be self-containing and self-sustaining.

Keep a neat notebook record of each account with pertinent up-to-date records and data, personnel, credit position, past orders and calls. Don't trust to memory. Refer to your notebook before each call and carefully work out the details, in writing. Such notes are never objectionable to a buyer and often make your efficiency impressive. Immediately after each call make a written record of it in your notebook or on a regular sales report form, if available. Don't delay reports until the end of the day or the week-end. Don't waste a lot of time writing long, useless reports on nonproductive calls.

Be sure all conditions of a sale are understood. Get a written order from the buyer. Confirm verbal orders in writing. Follow up orders to make sure specifications and deliveries are as agreed. Keep the buyer advised of market conditions, special bargains and displays. Keep him informed of all developments of interest concerning his business. Through regular contacts, render such helpful personal service that the buyer is well satisfied with the confidence he places in you.

Enameled Chemical Equipment

Despite the large amount of glass-enameled equipment used in the process industries, few chemical engineers have been privileged to learn much about the special enamels used, about the requirements of fabrication or the methods used in manufacture. This article is believed to be the first ever to discuss these matters in detail.

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Urbana, Ill.

MOST CHEMICAL ENGINEERS are familiar with the use of enameled iron as a construction material for chemical processes. Its use for tanks, reaction vessels, pipes, and condensers is of long standing and its application to new processes is constantly being expanded.

The terms porcelain enamel, enamel, and glass lined are synonymous as applied to chemical engineering equipment. An enamel of this type, however, must not be confused with paints and lacquers as it is a thin layer of glass fused to the surface of a metal. The properties of enamel are the properties of the glass which is used and may vary between wide limits. The enamel used for a particular piece of equipment should be selected to meet the conditions for which the equipment is designed. The resistance to acids, alkalis, organic liquids, and solutions in general depends upon the composition of the enamel and the processing of it. Many enamels will withstand surprisingly variable conditions but where the service is severe, it is more economical to subject them only to the service for which they are designed.

Manufacture

The manufacturing methods for enamel-lined equipment have been improved greatly over the past decade. Modern equipment has been introduced, resulting in more efficient operations and a superior product. Extensive research has led to better enamels, better processing of the enamels, and much better control. A flow sheet giving the principal operations is shown on the opposite page.

Condensed from a paper presented at the Akron meeting of the American Institute of Chemical Engineers, May 16, 1939.

Design of Ware—The design of the shape of the ware to be enameled is a very important consideration which is often overlooked by the chemical engineer who is not familiar with the enameling process. In this design, the use to which the ware is to be put is of first importance but the facility of enameling and the probability of satisfactory service should also be considered. The requirements for the use of the product are not generally so exacting that it is not desirable to adjust the design to the characteristics of the engineering material being used.

The facility of enameling affects the cost, the kind of enamel which can be used, and the perfection of the finished product. Sharp edges and corners, projections such as lugs and small radius beads, and irregular shapes should be avoided. Square or rectangular shapes are always more difficult to manufacture than cylindrical or dish-shaped ware. The general shape may greatly influence the tendency to warp during firing and even more important the tendency to warp under temperature and pressure changes in service. Any change in the shape of the ware after it has cooled from furnace temperatures will result in premature failure of the enamel. Another important consideration in design is that of the thickness of the metal stock or casting used as it has a pronounced effect on the enameling operations.

Selection of Process and Enamel—The enamel tank manufacturer will, in most cases, have the responsibility for the selection of the process and the enamel as he is better qualified to do this. Cast iron is generally used for heavy ware such as fittings. The dry process is usually employed for enameling cast iron and the wet process for sheet steel ware.

Fabrication—The methods of fabricating the ware for enameling are similar to those used in other industries except that great care is necessary particularly with the welding. Castings must be designed so as to heat uniformly, being thicker at the edges or places which tend to heat more rapidly. There is always a best temperature for firing an enamel; therefore, to obtain a uniformly good coating over the entire surface of the ware, the entire piece must reach the maximum temperature at approximately the same time. Castings are, if possible, poured with the side to be enameled down so that the impurities will float away from the surface to be enameled.

The steel used is generally manufactured, or at least selected, for enameling. It must be uniform in thickness and the carbon content is generally about 0.20, or less, with fairly close specifications. Steel is frequently analyzed at the enameling plant and checked for enameling characteristics. The steel is fabricated cold and welded by either the acetylene or electric method. Arc welding is common, although this often necessitates annealing along the weld after it has been made.

Preparation of Surface—The surface for enameling must be thoroughly cleaned and since most chemical ware is large in size, pickling is not convenient. Cast iron is never pickled but can be sand blasted with either sand or steel grit while sheet

steel can be blasted only with sand. Steel shot is never used for ware to be enameled as it leaves a smudge on the surface, while steel grit embeds itself in sheet steel. Both actions cause the formation of defects in the enamel during firing. Steel tanks are practically always sand blasted.

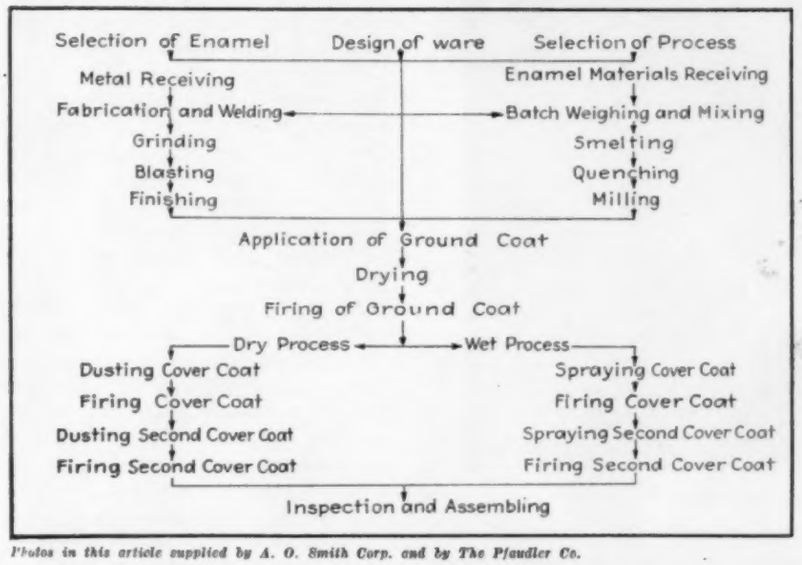
Enamel Preparation

The enamels used for chemical ware are practically always made in the plant where the enameling is being done. The raw materials are bought on specifications and are laboratory tested. In making the batch, they are weighed and thoroughly mixed, after which they are charged into a smelter where they are melted down to a molten glass. Both tank type and rotary smelters are used, the batch being carefully tested to determine the proper degree of smelting. The smelting is an important operation in the making of enamels as the properties of the finished ware are dependent to a great extent on the glass which is used.

When smelted to the desired condition, the molten glass is drawn off and quenched in a stream of water which shatters it to a granular mass called a frit. This frit is then dried and charged to ball mills for fine grinding. In the dry process, mill additions are generally not used but for the wet process, water is added as the vehicle and clay is used as the suspending agent. Electrolytes are required to aid in the control of the properties of the slip. The dry-ground frit comes from the mill as a powder passing a 100-mesh sieve. The wet-milled enamel comes from the mill as a slip or slurry with the consistency of thick cream. The control of the fineness, specific gravity and consistency has received a great deal of investigation and is a very complicated problem.

Application—The ground coat or first coat of enamel on chemical ware is generally applied by spraying the slip. This coating is then dried and the ware fired at about 1,600 deg. F. Ground coats for cast-iron ware are very refractory and viscous glasses which protect the iron from excessive oxidation at the temperature of the furnace. When properly fired down to a continuous glassy layer, the ware is removed from the furnace and the cover-enamel powder is dusted on to the hot ware. While one man dusts the enamel on the piece with a vibrating sieve, another one assists by op-

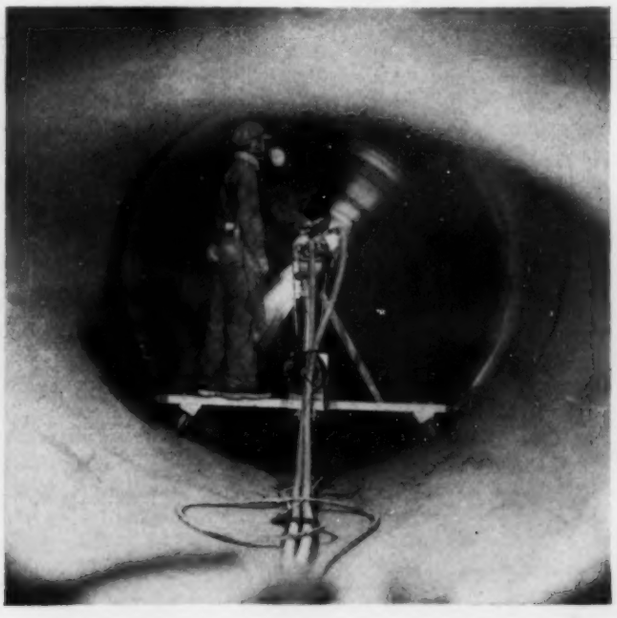
Flow sheet of enameled chemical equipment manufacture

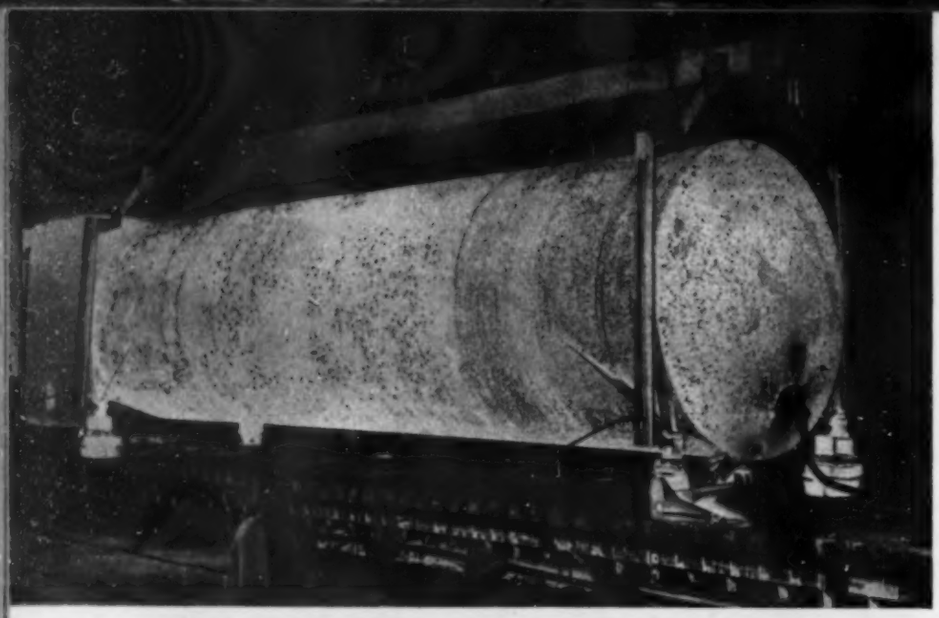


Photos in this article supplied by A. O. Smith Corp. and by The Pfaudler Co.

Sandblasting a sheet-steel tank for enameling

Automatic machine for spraying steel tank interior





White-hot enameled steel tank being removed from furnace

Inspecting glass-enamel lining in a steel tank

erating a jig which tilts the ware to different positions to facilitate the application. As soon as the ware is completely covered with the enamel, which sinters into place as it strikes the hot iron, it is returned to the furnace and the enamel fused down to a smooth layer of glass. Several applications may be necessary to obtain a perfect coating and then after the final firing, the ware is removed from the furnace and allowed to cool to room temperature.

Sheet-steel ware always receives a special ground coat containing about 0.5 per cent of cobalt oxide to give it adherence. During the firing of these cobalt ground coats, a reaction takes place at the interface of the enamel and the iron, resulting in the development of a bond between the two. The ground coat boils violently during firing but finally quiets down to a smooth continuous layer of glass. Before the cover coat is applied, the ware is cooled to room temperature. The cover enamel is then sprayed over the ground coat, dried, and the ware again brought to temperature in the furnace. More than one application of the cover enamel is often necessary, cooling and reheating with each application.

In some cases, the atmosphere of the furnace or within a tank is controlled to give more favorable conditions than exist in an ordinary muffle. It is desirable in firing large tanks to bring the ware up to a temperature of about red heat and then quickly change to an oxygen-free atmosphere. This eliminates the tendency to form copperheads and bare spots as it prevents the iron, which is exposed by the breaking of large bubbles in the enamel, from oxidizing and thereby forming a slag with the enamel. It was due to the development of this process that large tanks as much as 11½ ft. in diameter and as much as 45 ft. in length were first made successfully in one piece.

The temperatures used in firing enamels for chemical equipment vary ordinarily between 1,550 and 1,700 deg. F. depending on the size of the ware, the thickness of the stock, and the enamel used. The time required depends on the temperature employed and also the characteristics of the furnace. Both muffle and open-fired furnaces are used but in no case do the products of combustion come in direct contact with the enamel being fired.

The tools used to support the ware are generally of chrome-nickel alloy and designed so as to detract as little heat as possible from the ware.

Enamel Compositions—The compositions of typical enamels used for chemical ware are given in Table 1. Since such enamels are used for many different purposes, many modifications are necessary to meet the special conditions encountered.

Cast-iron ground coats are always fairly simple in composition and quite high in alumina and silica, with a comparatively low flux content, as they must be very viscous. They differ from other enamels also in that the fluoride content is either very low or omitted entirely. Fluorine induces good adherence in these enamels but tends to produce blistering. No effort is made to control color or opacity.

Cast-iron cover enamels are generally quite complicated as they contain many fluxes in an effort to produce low fusing compositions with a high degree of resistance to solution. Fluorine-containing compounds aid greatly in developing good workability in enamels but they are very detrimental to resistance to acids. Such compounds are, therefore, either low in amount or entirely absent. Barium and zinc compounds may be present and in some cases where lead is per-

Table I—Enamel Compositions

	Cast-Iron Ground Coat	Cast-Iron Cover Enamel	Sheet-Steel Ground Coat	Sheet-Steel Cover Enamel
Feldspar	56	27	32	32
Borax	30	33	30	30
Quartz	11	19	20	22
Soda ash	....	12	7	10
Sodium nitrate	....	4	3	3
Fluorspar	....	3	5	2
Cobalt oxide	....	2	0.5	0.5
Manganese dioxide	0.5	....	1.5	0.5
Nickel oxide	....	....	1.0	0
Mill Additions				
Frit	100	100	100	100
Clay	10	....	7	6
Borax	....	....	0.3	....
$MgCO_3$	....	....	....	2
Water	50	....	40	40

missible, it is used to advantage. The thermal expansion of enamels can be conveniently controlled by adjusting the sodium oxide and the boric oxide contents, the former raising the expansion and the latter lowering it.

Sheet-steel ground coats always contain about 0.5 per cent of cobalt oxide to give the enamel good adherence to the steel. Other color oxides, such as nickel and manganese, aid the adherence when cobalt is present but do not function alone. The feldspar, borax, and quartz contents of these enamels generally amount to 75 to 80 per cent of the composition. Soda ash and sodium nitrate control the thermal expansion and make up 10 to 12 per cent. Amounts up to 8 per cent of fluorspar are used to aid the workability of the enamel. This makes the enamel heal over better after the ground coat ceases to boil during firing.

The sheet-steel cover enamels used on chemical ware are generally highly resistant to acids, although in some cases they are designed for resistance to alkalis or special conditions. The acid resistant enamels are generally low in fluorides and alumina and high in silica and soda. Sodium silicofluoride is the least detrimental of the fluorides but sometimes fluorspar is used in small amounts as it contributes calcium. Titanium dioxide is often used as a partial substitute for silica, giving better fusibility and no decrease in resistance to acids. Since color is not an important consideration, these enamels are frequently blue, as blue gives a good appearance and tends to heal ground coat defects. Where not objectionable, lead is a good flux. Zinc oxide, barium carbonate, and boric oxide are other fluxes. Boric oxide in excess makes the enamel very difficult to keep in suspension in the slip form and causes defects in firing. The white enamels used for household purposes are more difficult to make resistant to solution as a considerable fluoride content is desirable to develop as much opacity as possible.

Properties and Tests

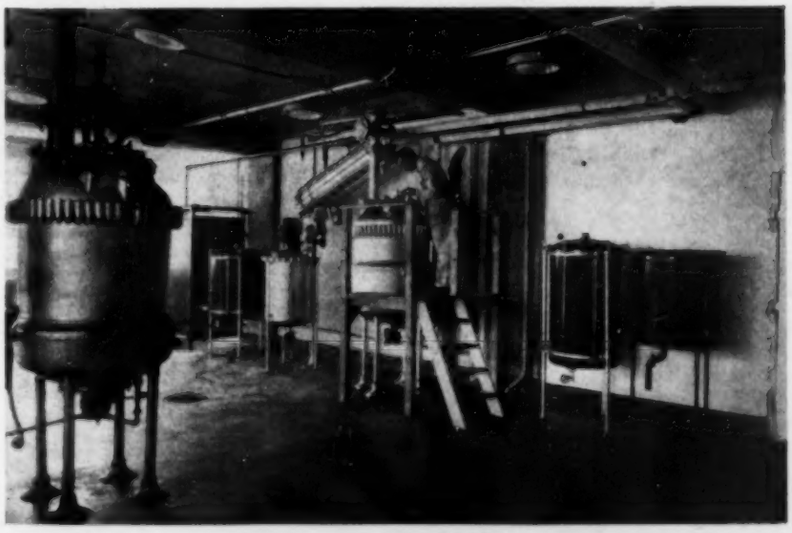
Like glasses and other materials, enamels do not combine excellence in all respects in one composition. If high acid resistance is desired, some sacrifice is necessary in alkali resistance. An enamel suitable for an autoclave might not necessarily be resistant to strong acids. Enamels for chemical equipment should be tested for the service to which they are to be exposed and not for other unnecessary properties.

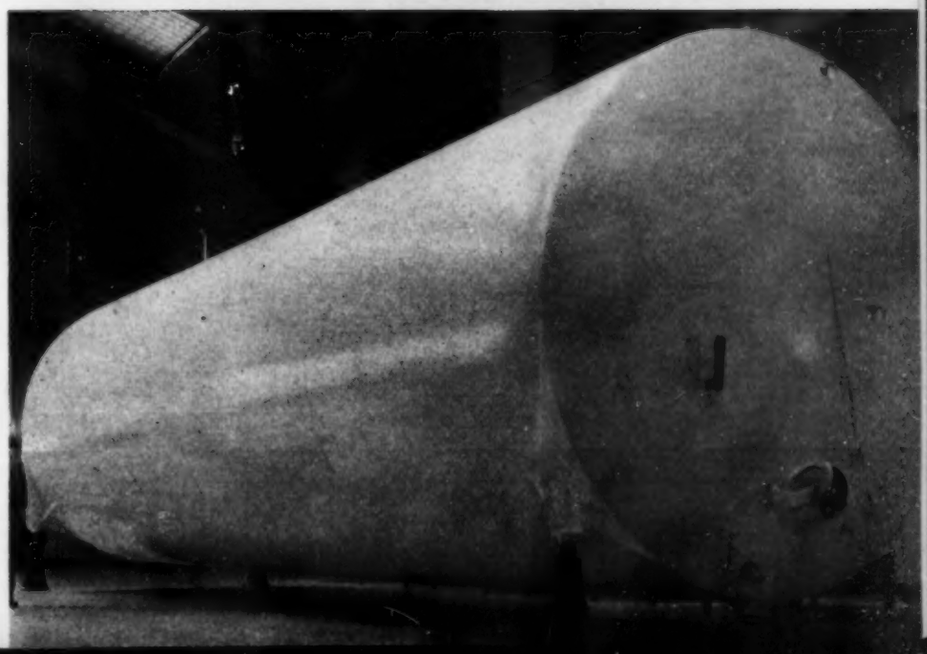
Chemical Durability—Enamels are made which are resistant to many severe conditions for which there is no other satisfactory material. They can be made resistant to all acids except hydrofluoric. They are very resistant to salt solutions and most organic liquids, oxidizing and reducing conditions, and electrolysis. When used under pressure, tests should always be made for durability under these conditions. The companies making chemical ware are all willing to submit small convenient samples on which tests can be made by the customer. With the variety of service conditions encountered, the standard tests on acid resistance are not applicable.

In addition to the consideration of the durable properties of the glass, the coating itself should be carefully inspected and tested. All enamels contain microscopic bubbles which are an essential part of the structure of good enamels. These bubbles, however, must not be large and they should not be close to the surface of the coating. A test with a knife point drawn over the surface of an enamel should not produce a ticking noise which indicates the breaking of bubbles in the enamel surface. The coating should be impermeable to an electric current. For severe acid corrosion service, one method of testing is that of applying about 1,000 volts to the enamel surface through a fine copper or brass bristle brush. This can be accomplished by using an ordinary neon display transformer, operating from a 110-volt line, and properly tapping the primary and secondaries to obtain the desired 1,000 volts. This test will indicate "weak

Group of enamel-lined stills, kettles and tanks

Glass-lined storage and aging tank for beer





spots" or spots where a large bubble underlies the surface of the enamel. The voltage disrupts the thin film of glass covering the bubble and between the bubble and the iron, and the current arcs to the metal. The spots are located by the arcing and by the resulting small black hole left in the coating. Some of these weak places are likely to occur in any large tank but they should not be numerous. The defective places should be patched with gold as later described.

The iodine test is a very simple test which will detect cracks but not bubbles. The vapor of an iodine crystal placed under a glass cover and over a suspected spot will corrode severely through a crack if left for 8 or 10 hours. Another test is the salt sponge test. A salt sponge is connected to a battery current and a milliammeter with the other contact on the metal of the tank. Any hole in the coating will be noted by the deflection of the milliammeter.

Enamel Thickness—The thickness of an enamel varies considerably with the type of ware but should not generally exceed 0.080 in. and should be fairly uniform over the entire surface. It should not be excessively thick on beads and in grooves. The thickness can be measured very conveniently with a General Electric thickness gage.

Impact Resistance—No satisfactory method has been devised for measuring the impact resistance of an enamel on a finished piece of ware. The manufacturers, however, measure this property in developing new enamels and it is given important consideration.

Since porcelain enamels are glass, they must not be struck with a sharp hard instrument. One can strike the enamel with all his force with a large wooden mallet without damage, but he can chip it readily with a heavy tack hammer properly applied. Except for the impact of a sharp blow which will crush the glass, the enamel does not break unless the steel supporting it is deformed.

Thermal Shock—Thermal shock should never be great enough to deform the ware. The enamel manufacturer gives thermal shock all due consideration in selecting and developing enamels but if the ware is actually deformed by unequal heating, the enamel will fail. Little difficulty should be encountered in ordinary service.

Thermal Conductivity—Although no extensive work has been reported on the thermal conductivity of enameled iron, the data by E. P. Poste are especially applicable to enameled chemical ware. They are shown in Table II.

Hardness—The scratch hardness of enamels does not vary greatly except as it is influenced by the bubble structure. Enamels which contain a great many bubbles or large ones are much less resistant to scratching and abrasion than those containing only the normal amount. The hardness on the Moh's scale varies from 5 to 6.

Physical Properties—The physical properties of enamel glasses are shown in Table III. These properties are dependent on the chemical composition and vary over rather wide ranges. Certain of the properties of enamels and glasses are approximately additive, the factors used being indicated in Table IV. The sum of the product of the factor, times the per cent of the oxide, gives the approximate value for the property of the particular glass.

Table II—Over-all Coefficients of Heat Transfer in Enameled Steel Ware

Conditions	B.t.u. per Hr., Sq. Ft., and °F.*	Over-all Coefficient, Joules per Sq. M., Hr. and °C.†
Steam, to water being heated	80–140	1,674–2,929
Hot water, to water being heated	70	1,464
Steam, to boiling water	140	2,929
Steam, to a thick fruit product	32	669
Cooling hot water, by cold water and brine	40–120	837–2,510
Hot oil, to oil being heated	13–24	271–586
Hot oil, to boiling water	30–40	628–837
Steam, to water being heated in tubular heater	100–160	2,092–3,347
Steam being condensed, to water in a tubular condenser jacket	140	2,929

* E. P. Poste, *J. Ind. Eng. Chem.*, **16**, 469 (1924).
† International Critical Tables II, 116.

Table III—Physical Properties

Hardness	5–6	Moh's scale
Elasticity*	4,950–7,480	Kg per sq. mm.
Tensile strength†	42,000–64,000	Lb. per sq. in.
Specific gravity	2.54–2.66	Lead bearing, 3.32–3.79
Thermal expansion	246–390×10⁻⁷	
Fusibility	500°C. and up (gradual softening)	

* C. W. Parmelee, L. D. Fotterolf, *J. Am. Ceram. Soc.*, **12**, 193 (1929).
† A. I. Andrews and W. W. Coffeen, *J. Am. Ceram. Soc.*, **22**, 11 (1939).
C. W. Parmelee and R. G. Ehman, *J. Am. Ceram. Soc.*, **13**, 475 (1930).

Patching Damaged Enamel

The patching of defects or damaged spots on enamel ware has received a great deal of investigation and several very satisfactory methods have been devised. The gold patch is probably best. Acidproof cement and sprayed metal patches are also used.

Gold Patch—The gold patch is made in a manner similar to that used by a dentist in filling teeth. The defect is drilled out clean with a dental drill, leaving a hole through the enamel to the metal base with a slight under cutting to provide anchorage. The bottom of the hole should be slightly larger than the opening. Sponge gold, electrolytic 100 per cent pure gold, which has been dried at a red heat, is then tamped in, using a dental plugger or automatic dental hammer. This type of patch has been used for years and has proven reliable in severe service. Such patches are satisfactory up to 5/16 in. in diameter and the cost is very small.

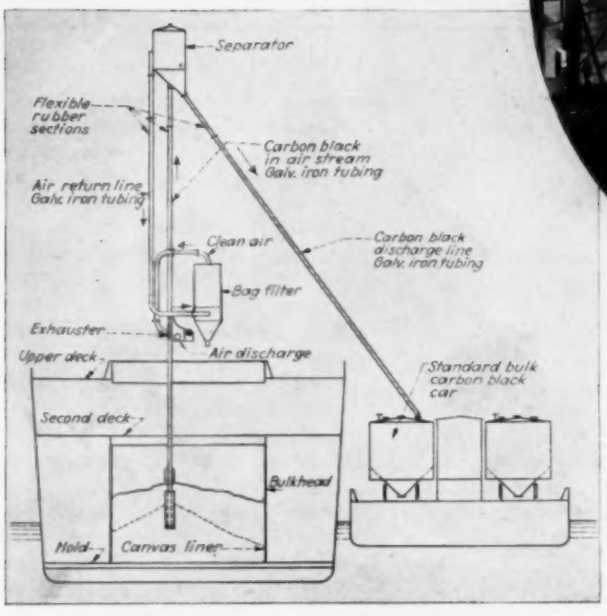
Table IV—Factors for Calculating Physical Properties of Glasses and Enamels

Key: M. & H.—Mayer and Havas. W. & S.—Winkelmann and Schott, Jena Glass. E. & T.—Corrected to, English and Turner, *J. Am. Ceram. Soc.* **12**, 760 (1929). F. & P.—Fetterolf and Parmelee, *J. Am. Ceram. Soc.*, **12**, 214 (1929). P. & F.—Paalborn and Focke, Jena Glass. Baillie—*J. Soc. Chem. Ind.*, **40**, 141 (1921), C. & T.—Clark and Turner, *J. Soc. Glass Tech.*, **3**, 260 (1919). H. & C.—Hodkin and Cousen, "Glass Technology," Constable & Co., Ltd. (1925).

Composition	Thermal Expansion M. & H.* ×10⁻⁷	Thermal Expansion W. & S. ×10⁻⁷	Thermal Expansion E. & T. ×10⁻⁷	Thermal Expansion F. & P. ×10⁻⁷	Heat Conductivity P. & F.	Density W. & S.	Density Baillie	Tensile Strength W. & S., Kg. per Sq. Mm.	Crushing Strength W. & S., Kg. per Sq. Mm.	Elasticity C. & T.	Hardness, Auerbach	Specific Heat H. & C.
SiO_2	0.8	0.8	0.15	.....	0.0220	2.3	2.24	0.09	1.23	40	+3.32	0.001913
Al_2O_3	5.0	5.0	0.42	.....	0.0220	4.1	2.75	0.05	1.0	120	+10.1	.....
B_2O_3	0.1	0.1	−1.98	.....	0.0160	1.9	3.00	0.065	0.90	.....	+0.75	0.002272
Na_2O	10.0	10.0	12.96	12.5	0.0160	2.6	3.20	0.02	0.52	110	−2.65	0.002674
K_2O	8.5	8.5	11.7	.....	0.0010	2.8	3.20	0.01	0.05	.....	+3.9	0.001860
PbO	4.2	3.0	3.18	.....	0.0080	9.6	10.30	0 025	0.48	.....	+1.45	0.000512
ZnO	2.1	1.8	2.1	1.85	0.0160	5.9	5.94	0.15	0.6	.....	+7.1	0.001245
CaO	5.0	5.0	4.89	.....	0.0320	3.3	4.30	0.20	0.20	240	−6.3	0.001903
MgO	0.1	0.1	1.35	.....	.....	3.8	3.25	0.01	1.1	300	.....	0.002439
BaO	3.0	3.0	4.2	5.7	0.0110	7.0	7.20	0.05	0.65	.....	+1.95	0.000673
As_2O_3	2.0	2.0	.....	.....	.....	4.1	2.90	0.03	1.00	.....	.....	0.001276
P_2O_5	2.0	2.0	.....	.....	0.0160	2.55	.....	0.075	0.76	.....	+1.32	0.001903

* Also Sb_2O_5, 3.6; SnO_2, 2.0; TiO_2, 4.1; ZrO_2, 2.1; Na_3AlF_6, 7.4; NaF, 7.4; AlF_3, 4.4; CaF_2, 2.5; Cr_2O_3; 5.1; CoO, 4.2; CuO, 2.2; Fe_2O_3, 4.0; NiO, 4.0; MnO_2, 2.2.

Novel Transportation



Experimental coastwise shipment proves novel procedure is cleaner than handling carbon black in the usual export paper package. These pictures show discharging operations

On April 30, the S. S. Prusa sailed from Corpus Christi, Texas, and on May 9 arrived at Boston Mass., with a 150,000-lb. cargo of Spheron carbon black in her forward hold—the first bulk shipment of its kind ever made by water. To the engineers of Godfrey L. Cabot, Inc., goes the credit for developing a unique method of successfully loading, unloading and transporting carbon black in cargo vessels.

After more than two years of investigation a small-scale, portable equipment for the transfer of the carbon black to and from the cargo hold was developed. This equipment operates on the principle of a vacuum cleaner, and makes use of a specially constructed suction nozzle, a centrifugal separator and a standard dust removing machine. In loading the black flowed from "tank" cars into a large hopper, from which it was drawn up to the separator by a rapid but gentle stream of air. In the separator the air was removed from the black and was returned to the dust remover, cleaned, and discharged. The black flowed by gravity from the separator into the hold of the ship.

A large, dust-tight canvas hold liner filled the bulkhead, and into it the carbon black poured through a small-funnel-shaped opening. The full load of material was topped off in a conical heap, the opening in the bag was sealed tightly, and the shipment was ready for sea. The portable apparatus was loaded aboard, to be used there in unloading.

There was complete absence of any trace of black dust, either outside or inside the wooden bulkhead or on top of the hold liner itself; and although the operation was under constant critical supervision there was apparently no possibility of contamination of the carbon black by foreign substances.

The unloading process was the exact reverse of the loading procedure, except that the "tank" cars were moored on a barge alongside the steamer, thus eliminating the need of adjustments for tide.

If the engineering and operating problems disclosed by this experiment can be solved as successfully as its primary objectives of cleanliness and freedom from contamination have been met, then many of the obstacles now in the way of bulk marine shipments may eventually be overcome.

The portable dust remover and air exhaust were re-erected over the cargo hatch; the centrifugal separator was slung above the hold at the end of the jumbo boom; and the delivery pipe led over the vessel's side to the "tank" cars. As the amount of carbon black in the ship's hold diminished, the sides of the canvas hold liner were drawn up so that the carbon black flowed toward the center, where the nozzle was suspended.

Multi-Layer Thick Walled Vessels

Disappointed by the failure of small-diameter, thick walled pressure vessels to give as good performance as would be expected from theory, since 1931 the author's company has been experimenting with and building for use vessels fabricated of a considerable number of layers of steel, each layer wrapped on and welded at the edges.

T. McLEAN JASPER
A. O. Smith Corp.
Milwaukee, Wis.

MULTI-LAYER construction for pressure vessels is a development that has grown out of the failure of small thick walled, high pressure vessels to give the service expected of them. Several years ago the A. O. Smith Corp. constructed four welded pressure vessels, 12 ft. long, with a 33¼-in. outside diameter and a total wall thickness of 3⅝ in. These vessels were all tested to destruction and in no case was the pressure at failure more than 75 per cent of that expected according to commonly accepted cylinder formulas. It was concluded that the accepted formulas were not applicable for vessels in which the ratio of diameter to wall thickness was 10 or less. The literature failed to disclose records of previous simjlar tests on vessels of these dimensions, and an active search for improved construction ideas was instituted. The resulting multi-layer construction was found to show marked superiority to other proposed methods and has since been patented, tested carefully and installed in a number of plants for high temperature hydrogenation, gas separation, high pressure chemical processes, hydraulic press service, high pressure gas storage, and air-liquid accumulators.

Multi-layer vessels are constructed of several layers of de-scaled steel, each progressively wrapped and tightened around the cylinder by mechanical means and then welded together at the edges. The thickness of each outside layer is generally less than ¼ in., whereas the inside layer may be heavier. Only the inside layer is leakproof, each subsequent layer being perforated for venting. After all layers have been added, the ends are machined for the welding groove. Contact between layers is so uniform that it is difficult to determine from visual inspection that the vessel is not of solid construction. With the ends machined, the sections are then assembled by welding much as the sections of ordinary solid walled, welded vessels are joined.

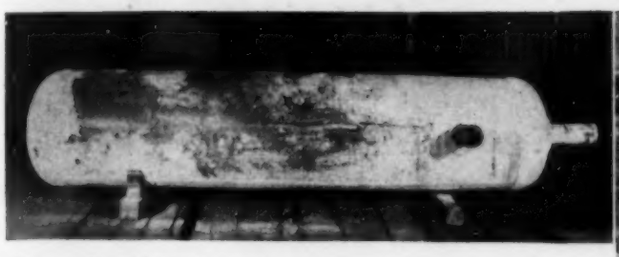
In 1931 two of these vessels were constructed with 12 layers of ordinary boiler steel of varying thicknesses, totalling about 3.85 in. The outside diameter was 27 in. and the length about 9 ft. between heads. When tested to destruction the vessels failed at hydraulic pressures of 19,100 and 20,200 lb. per sq. in. respectively, which according to the formula $s = pDm/2t$ gave corresponding stresses of 58,000 and 62,000 lb. per sq.in. The top left view on the opposite page, showing one of these vessels after rupture, indicates a type of failure strikingly different from the shattering encountered with solid walled vessels. There was no shattering, but a considerable amount of deformation.

Six years later two additional multilayer vessels were tested to destruction to establish information on the design of large openings and on the effect of stress relief. The two vessels were substantially the same size as the earlier test vessels and the corresponding layers of each were taken from the same steel sheet to ensure similarity. One vessel was stress-relieved at 1,150 deg. F. while the other was not. The first (stress-relieved) failed at a pressure of 17,375 lb. per sq. in. (55,900 lb. stress) while the second failed at 18,800 lb. per sq.in. pressure (60,400 lb. stress). The imposition of compressive stresses on the inner layers of the unrelieved vessel is believed to account for its better performance. Consequently, stress relief is not recommended for layer construction. It has been shown quite definitely that when at least one of the surfaces to be welded is made up of a multiplicity of layers, the circular joints do not and cannot set up internal stresses which require stress relief.

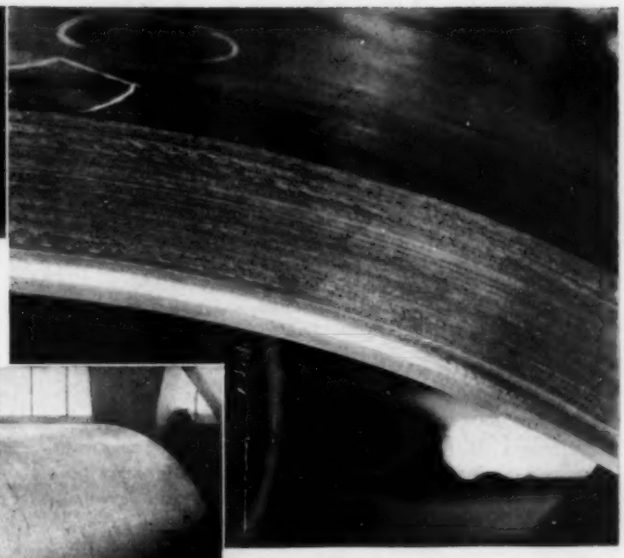
Since 1931 a considerable number of layer vessels have been constructed and put into service. The first of these, built in 1931, has been operating since at 2,000 lb. pressure. Another, with an outside diameter of 28¾ in. and a wall thickness of 3⅞ in. is in operation at 5,000 lb. pressure. The accumulator at the lower left opposite has an outside diameter of 56.6 in., a wall thickness of 5.3 in., a length of 30 ft. 9 in. and operates at 3,250 lb. pressure. Other similar examples could be cited.

Multi-layer vessels have been found to have a number of attractive features. This construction gives wide flexibility in size and weight compared to thick single-piece equipment. Although the heaviest vessel of this type built so far weighed but 110,000 lb. in comparison with over 400,000 lb. for single-plate welded vessels, a great increase in possible weight can be expected. A considerable advantage lies in the minute scrutiny which can be given to each thin layer as it is added during construction. An important feature is that the inner layer can be of any desired corrosion resisting material, no matter how costly, with the outer layers of the most economical material for the service. Finally, the lower cost of equipment used in fabricating multi-layer vessels gives an advantage in production cost as compared with thick solid wall construction.

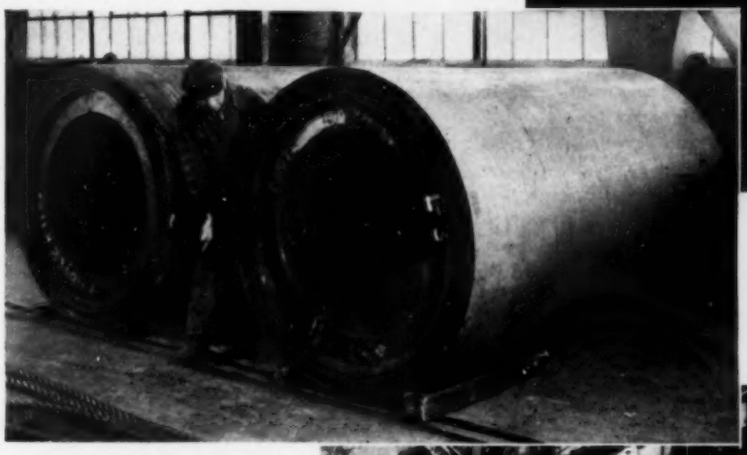
Based on a paper presented by the author under the title of "Multi-Layer Construction of Thick-Wall Pressure Vessels," before the New Orleans meeting of the American Petroleum Institute, May 17, 1939.



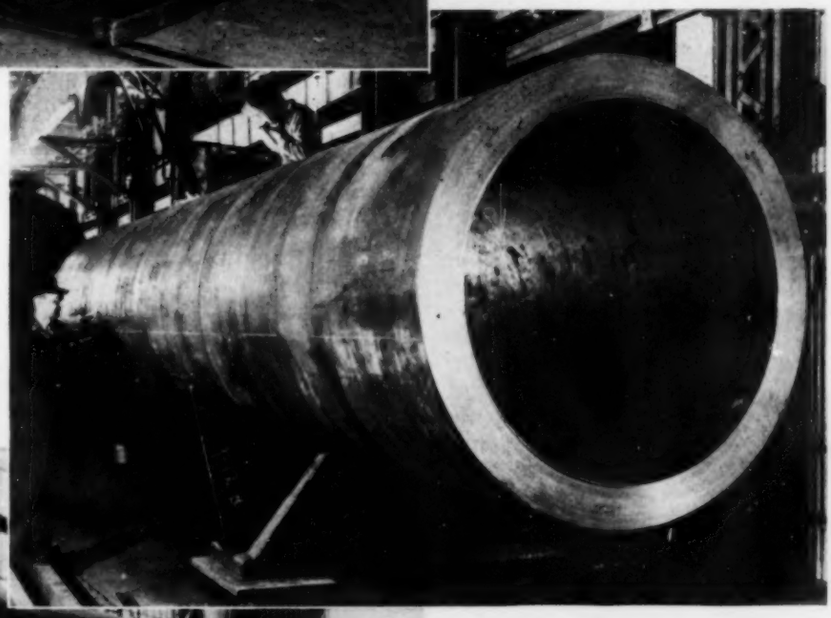
Above—Tested to destruction this multi-layer vessel failed without shattering and with considerable deformation; the pressure at failure was accurately predictable



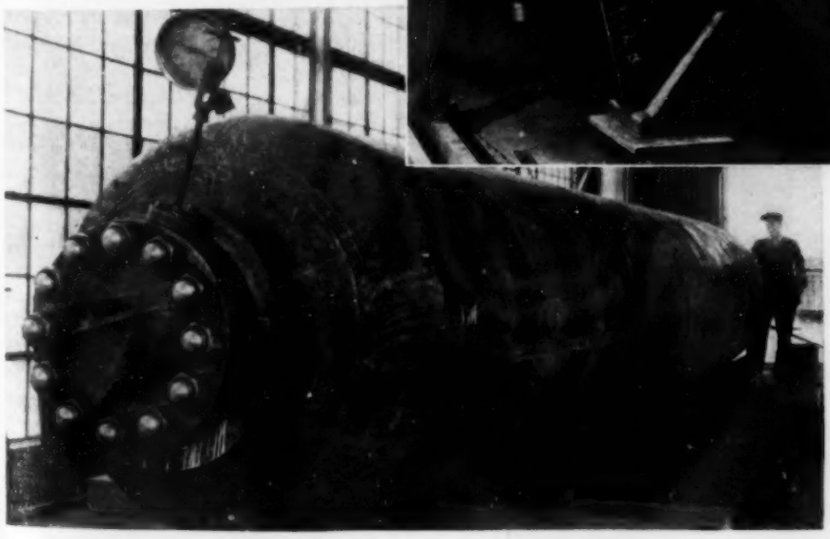
Above—This close-up of the machined end of a multi-layer cylinder shows the tightness of the fit between layers. It is difficult to tell visually that such vessels are not one-piece



Above—Two sections of a multi-layer vessel shown after 26 layers have been wrapped on and welded. The rings in the ends are used to guide the formation of the first few layers



Below—This accumulator of multi-layer construction is shown being tested at a pressure of 6,500 lb. per sq. in. The working pressure is 3,250 lb. per sq. in. and the weight, 94,000 lb.



Above—Sections of multi-layer vessels are joined by welding, much as in the case of thick-walled vessels made of a single thickness of plate. In the case of vessels having a wall thickness of more than 10 per cent of the diameter, however, the author has found that the usual formulas are reliable only with the multi-layer vessels. The vessel shown here under construction has a total wall thickness of 5.6 in., and consists in all of 26 layers

Predicting Rotameter Calibration

An editorial interpretation of a paper by E. M. Schoenborn, Jr., and A. P. Colburn, of the University of Delaware, in which experimental proof is given that rotameter flowmeters can be analyzed mathematically and calibration predicted.

WITH the recent rapid increase in the use of the rotameter type of fluid metering device (see Fig. 1) it has become imperative to analyze its principles mathematically so as to permit calibration with a minimum of effort. In the past a limitation has been that a calibration curve on one fluid could not be used in predicting readings on another fluid of different properties, even with the same instrument. Furthermore, a change in the dimensions of the tube or float, or in the specific gravity of the float, affected the calibration data.

Past attempts at such an analysis have not been particularly successful. The authors started their investigation with the assumption that a rotameter did not differ materially from an orifice meter despite the fact that the former uses a variable annular orifice and a constant pressure drop through the orifice, the reading being determined by the elevation in the tapered tube at which the float rides to secure this constant pressure drop; while the orifice meter employs a fixed circular orifice and a variable pressure drop which is measured in terms of flow rate by means of a manometer. The authors reasoned that the unbalanced pressure acting upward on the float due to the flow of the fluid through the annular orifice around the float must equal the downward tendency of the float due to gravity if it is to remain at a constant level in the tapered tube, or that $(P_1 - P_2)S_f$, the upward pressure due to the fluid flow, must equal $v_f(\rho_f - \rho)$, the downward force due to gravity. Here P_1 and P_2 are the pressures below and above the float, respectively; S_f is the maximum cross-sectional area of the float; v_f is the volume of the float; and ρ_f and ρ are the densities of the float and fluid, respectively (all in consistent units). Hence $(P_1 - P_2)$, the pressure drop through the annular orifice, is equal to $v_f(\rho_f - \rho)/S_f$ which, divided by ρ gives the pressure drop H expressed in head of the fluid flowing,

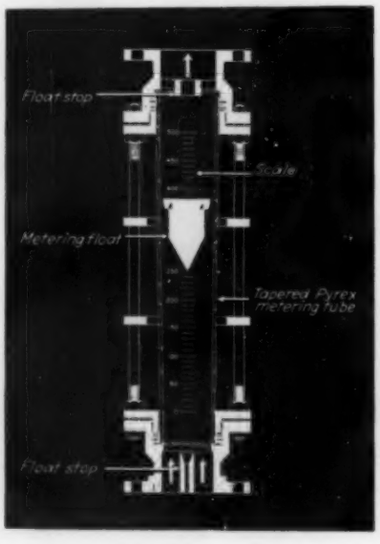
$$H = v_f(\rho_f - \rho)/S_f\rho^* \qquad (1)$$

It was then argued that since the flow through an orifice meter expressed in terms of the drop in fluid head is $q = S_oC_o(2gH)^{\frac{1}{2}}$ (where q is the flow rate, S_o is the orifice area, C_o is the discharge coefficient and g is the acceleration of gravity), then if the rotameter followed the same type of law, its flow should be expressed by the same equation, with the proper value of H used, or

$$q = S_oC_f[2gv_f(\rho_f - \rho)/S_f\rho]^{\frac{1}{2}} \qquad (2)$$

where C_f is the discharge coefficient peculiar to the rotameter under the conditions of operation. If C_f were a constant the determination of q would be simple, but it will be observed from the equation that at any given flow rate C_f depends on the density, volume and cross-sectional area of the float, the density of the fluid, and the area of the orifice.

Fig. 1—Typical Fischer & Porter rotameter in cross section



In order to determine how C_f varied with different fluids the authors calibrated a small instrument (rotameter A) on water, fuel oil and air, using seven positions of the float covering nearly the whole range of the instrument with each fluid. The meter tube had an inside diameter of 0.510 in. at the zero reading, and 0.638 in. at 250 mm., with uniformly tapered side walls between. The float had a maximum diameter (top) of 0.497 in., a weight of 10.5221 grams, a specific gravity of 8.49 (bronze) and a volume of 0.0756 cu. in. The density and viscosity of the water, oil and air were taken as 62.37 and 0.000739; 54.27 and 0.002912; and 0.075 lb. per cu. ft. and 0.0000124 lb. per sec. ft.

The flow rates obtained with each of the seven float positions for the three fluids were then substituted in Equation (2) and the C values plotted against a modified Reynolds number, $D_{eq.}V\rho/\mu$, in which $D_{eq.}$ is the "equivalent diameter," equal to the difference in diameters of the tube (at the level of the float) and the float itself; V is the average velocity through the annular orifice; and μ is the viscosity of the liquid. As shown in Fig. 2, slightly different curves were obtained for the three fluids, which is comparable to the variation

Based on a paper presented by E. M. Schoenborn, Jr., and A. P. Colburn, both of the Chemical Engineering Div., University of Delaware, Newark, Del., at the Akron meeting of the American Institute of Chemical Engineers, May 17, 1939. The original title was "The Flow Mechanism and Performance of the Rotameter."

* To make certain that this expression is valid the authors carefully measured the pressure drop across the float at various rates of flow, using both air and water as the fluid. The method was to measure the drop in pressure through the entire meter, both with and without the float in place, the difference giving the drop due to the float alone. Surprisingly close agreement between calculated and experimental values H was obtained.

in C_o found in the case of orifice meters, at low Reynolds numbers, for different ratios of orifice to pipe diameter.

Data on a second meter (rotameter B) were supplied by the manufacturers, Fischer & Porter Co., Philadelphia. These covered seven different float positions on six different oils and water, the oils ranging in density from 55.61 to 58.24 lb. per cu. ft., and in viscosity from 10.2 to 72.1 centipoises (0.000683 to 0.0485 lb. per sec. ft.). In this meter the inside diameter of the tapered tube was 2.99 in. at the zero reading and 3.54 in. at the 354 mm. reading. The float had a top diameter of 2.95 in., a weight of 6.4375 lb., a specific gravity of 7.92 (stainless steel) and a volume of 0.0135 cu. ft. The Reynolds number and C value were similarly calculated for each fluid and flow rate for this instrument, and again plotted, as in Fig. 3, with all data falling on a single curve in this case. Whether the difference between Figs. 2 and 3 represents the effect of a size factor or arises from differences in shape of float is something the authors intend to investigate later.

Predicting Calibration Data

Because Figs. 2 and 3 have the flow rate in both coordinates, they are not convenient for use in flow rate calculations. In Fig. 4 this difficulty is obviated by dividing one coordinate by the other so as to cancel out the flow rate. The data of Fig. 3 are used. Dividing the Reynolds number by C gives $\mathrm{Re}/C = D_{eq.}\rho(2gH)^{\frac{1}{2}}/\mu$. The value of $D_{eq.}$, it will be noted, comes from the reading of the instrument, but all other values depend on the properties of the fluid and float. Hence, for a rotameter for which such a curve applies, C and hence the flow rate for any reading may easily be calculated.

As an example of predicting flow rates, assume that water calibration data have been secured on rotameter A, but that the only C vs. Re/C curve available is that of Fig. 4. The accompanying tabulation lists the calculations made on a fuel oil and it will be noted that calculated and observed results are surprisingly close, considering that rotameter A gave several different C curves (Fig. 2). Thus it will be seen that Fig. 4 can be used as a first approximation even when no C vs. Re/C curve is available for the instrument in question.

Still more accurate results are possible when converting known flow rates at various readings on one fluid to rates on another fluid for the same instrument. Here a ratio may be set up,

$$q_2 = q_1 C_2 H_2^{\frac{1}{2}} / C_1 H_1^{\frac{1}{2}} \qquad (3)$$

First construct a C vs. Re/C curve using data for the known fluid. Then compute H and Re/C for the two fluids at various readings. Finally determine values of C_1 and C_2 from the plot and calculate q_2 at each flow rate.

For example, suppose it is desired to determine the rate of flow of an oil having a specific gravity of 0.936 and a viscosity of 0.0485 lb. per sec. ft. at a reading of 200 on rotameter B. At this reading, the rate of flow of water at 20 deg. C. is 62.7 g.p.m. For this case the C vs. Re/C curve is given by Fig. 4. Then H_1 from Equation (1) is $0.01305 \times (7.92 - 1)/(0.0476 \times 1) = 1.90$ ft. of water. H_2 similarly is $0.01305 \times (7.92 - 0.936)/(0.0476 \times 0.936) = 2.05$ ft. of oil. For water $\mathrm{Re}/C = 0.351 \times 62.3 \times 64.4^{\frac{1}{2}} \times 1.9^{\frac{1}{2}}/(12 \times 0.000672) = 30{,}000$ and for oil $\mathrm{Re}/C = 0.351 \times 58.24 \times 64.4^{\frac{1}{2}} \times 2.05^{\frac{1}{2}}/(12 \times 0.0485) = 405$. Then from Fig. 4, $C_1 = 1.03$ and $C_2 = 0.6$. From Equation (3), $q_2 = 62.7 \times 0.6 \times 2.05^{\frac{1}{2}}/(1.03 \times 1.9^{\frac{1}{2}}) = 38$ g.p.m. From the calibration on this oil supplied by the manufacturer, the flow rate corresponding to this reading was actually 37.5 g.p.m.

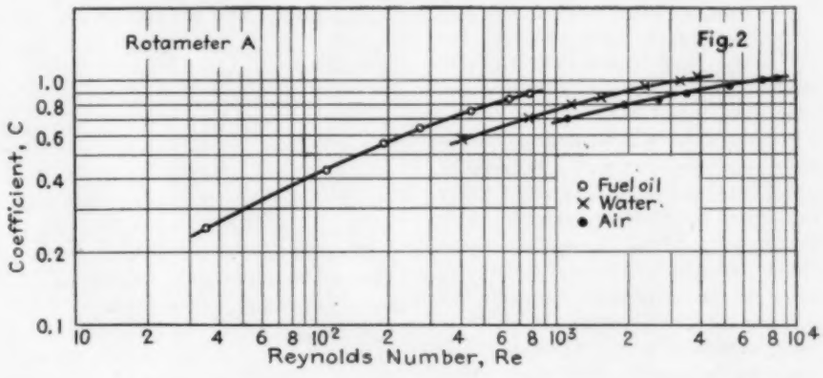
Prediction of Flow Rate

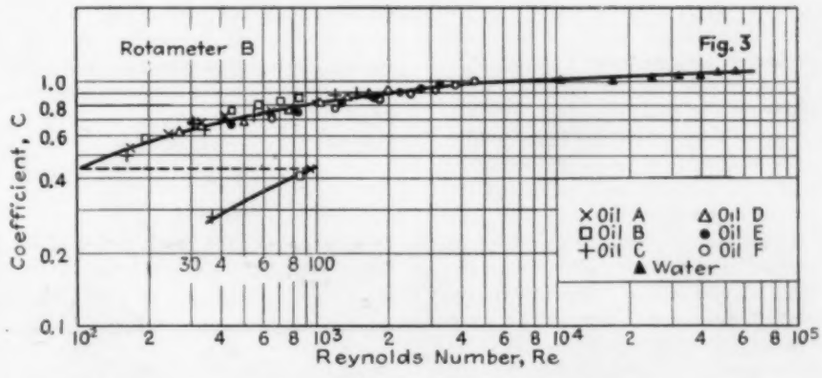
(Water calibration known; Fig. 4 available; find calibration for fuel oil of density 54.27 lb. per cu. ft. and viscosity 0.002912 lb. per sec. ft.; H for water = 0.243 ft. of water and for oil, 0.283 ft. of oil.)

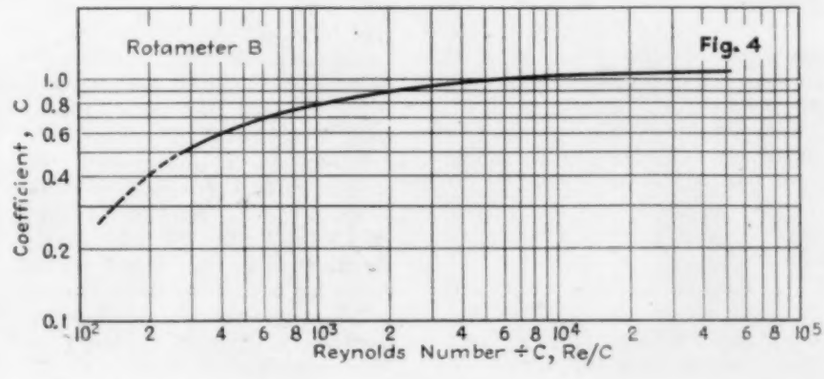
Rdg. mm.	Water Rate $q_w \times 10^3$	C_w*	C_o*	Calc'd $q_o \times 10^3$	Obs'd $q_o \times 10^3$
25	0.332	0.74	0.29	0.14	0.157
50	0.62	0.80	0.49	0.41	0.403
75	0.93	0.84	0.56	0.67	0.694
100	1.27	0.86	0.62	0.99	1.006
150	1.99	0.92	0.69	1.62	1.707
200	2.81	0.94	0.74	2.39	2.488
230	3.31	0.97	0.76	2.80	3.033

* Relative values from Fig. 4. Corresponding to the seven meter reading, for water Re/C is 718; 1,070; 1,430; 1,780; 2,500; 3,200; and 3,630. For oil Re/C is 140; 260; 340; 425; 595; 762; and 870.

Fig. 2—Plot of rotameter A coefficients vs. Reynolds number for three fluids
Fig. 3—Plot of rotameter B coefficients vs. Reynolds number for seven fluids
Fig. 4—Rotameter B coefficients plotted vs. Re/C for convenient use







Economy in Warehouse Design

Although the construction described here was designed specifically for use in the new whiskey warehouses built by National Distillers Products Corp. at its Carthage, Ohio, plant, it nevertheless contains many features that should be of value in buildings for the storage of a variety of other products.

THOMAS F. BROWN
Vice-President
National Distillers Products Corp.
New York, N. Y.

A WHISKEY WAREHOUSE is a large wooden rack, self-supporting and self-braced, surrounded by protective walls. This type originated several generations ago. Current cost comparisons with concrete, brick and other usual types of mill and fireproof warehouse buildings with solid floors show that it is still usually the most economical. These comparisons include construction, operation and maintenance costs, and of course, insurance rates. The racks are made of small members, bolted together. They could be designed to hold many other products than barrels, and given any type of inclosure which appearance, protection and economy demand.

One of the typical modern warehouses of National Distillers Products Corp. will store 50,000 barrels of a very combustible product having an insurable value of perhaps $5,000,000 or more, in such manner that each barrel may be inspected from both ends without moving adjacent barrels; will give year-round temperature control within about 2 deg. F.; and ventilation, lighting, sprinkler and elevator service, at a complete construction cost of from 10 to 13 cents per cubic foot, depending upon foundation conditions. The volume of a 50-gal. barrel is about 8 cu. ft. but space for handling and inspection aisles, proper ventilation and sprinklering, stairs, etc., brings the building volume up to about 35 cu. ft. per barrel. The cost per barrel of capacity will be $3 to $4, again depending on foundation conditions.

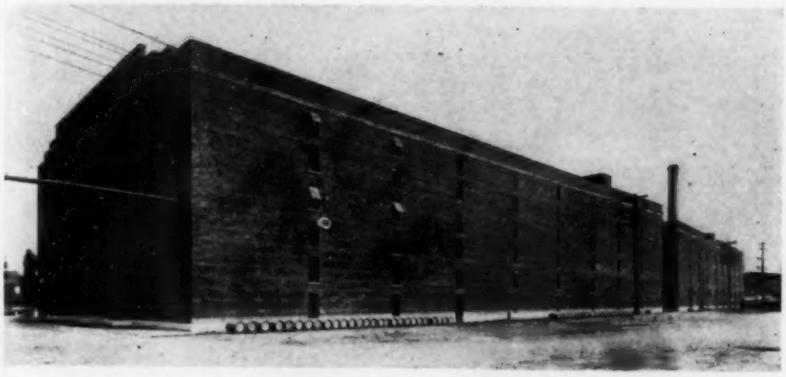
A section of the rack is shown in the drawings on the opposite page and in the view on the following page. These indicate how the barrels are arranged, 24 high and 44 across the 108-ft. wide building. The stiffening of such a structure containing about 1,200 columns on each floor, and more than 30,000 structural members, is a major problem. Improvements in design have reduced the rack lumber to about 18 board ft. per barrel stored, and the total rack weight to one-ninth the weight of the product. We believe we were the first to develop, in cooperation with our engineers, many of the construction and safety features which have made possible the present economical and safe storage.

Saving on Lumber

Fully seasoned lumber is too expensive; therefore part payment is made on green lumber held at the point of production for partial drying for several months if time permits. Mill work is minimized by designing with standard sizes. All fabrication is done from drawings, in a saw mill set up at the job, but bracing is cut to tight measure as the rack structure is erected.

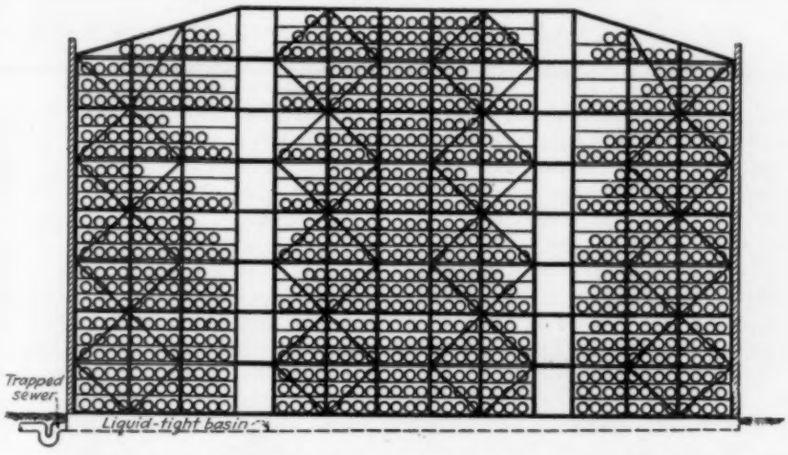
Transverse bracing is not difficult, as diagonals can be placed at intervals against the barrel-rack posts without taking up useful space. Bracing in the direction of the length of the building has often been either inadequate or space-consuming. In our present designs, sections of rack are omitted along lines across each building to create transverse aisles containing stairs and longitudinal bracing. Elevators may also be put here or in outside towers, depending on building code and insurance requirements. Supplementary lengthwise bracing is given by continuous timbers which help also to support the floors, and by continuous longitudinal

Our author, Col. Brown, is vice-president in charge of operations for his company and at the same time active in the U. S. Ordnance Reserve, where he was recently appointed assistant chief of the New York Ordnance District. Long associated responsibly with the Ordnance Department, after the World War Col. Brown became interested in designing and manufacturing operations in private industry. Indicative of his many professional activities is his membership in the American Institute of Chemical Engineers and other engineering societies.



One of the new National Distillers warehouses at Carthage, Ohio

Cross section through the whiskey storage rack indicating how lateral bracing is applied and showing the basin beneath the building



trusses under the roof. Only alternate working floors are made solid. These are tongue-and-groove planked, for fire stops, with sprinklers protecting the two intermediate stories.

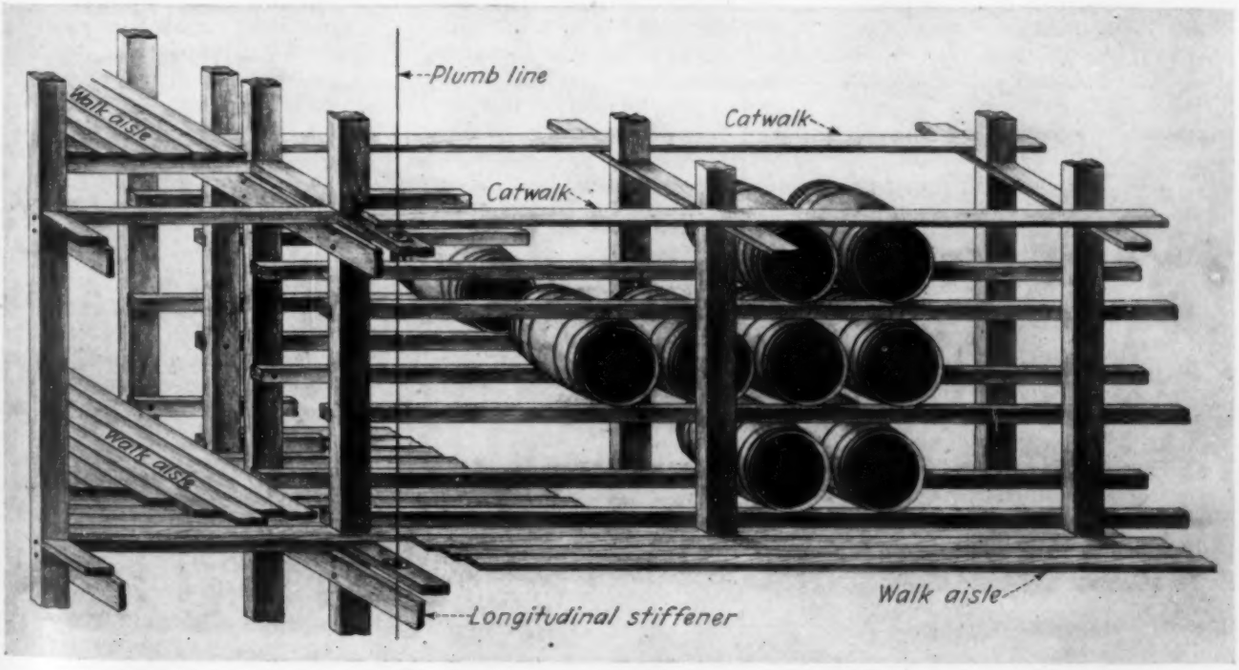
Supporting the Walls

The brick walls are tied to the rack structure by pivoted iron straps. These give horizontal support to the high straight walls, and allow settlement of the rack under load. We found a substantial saving in wall construction could be made by using double-size brick. Such brick are perforated vertically for weight reduction and bonding, and previously were classified by the insurance companies as tile, with a high insurance rate. We were able by selecting the proper design to have them classified as brick.

A very interesting and original feature developed to show movement of the rack is a series of steel plumb lines hanging from the roof to the basement through holes in the floors. At each floor level a metal plate with a 1-in. diameter hole is centered around each wire and fastened to the rack. A new rack 65 ft. high may settle materially when its load of about 12,500 tons is put on it. The plumb bobs show horizontal movements, usually due to warping of a few of the new timbers.

Heating is done by several unit

How the rack is framed; in effect each floor is an independent framework resting on the frame of the floor below



heaters on each "solid" floor, saving the space formerly taken by heating ducts. Care is required to avoid uneven heating with consequent warping, while the timbers are still green and the rack partially loaded. Floors containing whiskies of different ages or types may be held at different temperatures, eliminating the old-time "rotation" of the barrels from the lower to the upper floors.

A feature which is used in our warehouses, and now advocated by insurance underwriters, is a liquid-tight basin under the building. In case of fire the burning whiskey collects there and is drained away through pipes trapped to prevent fire getting outside the building lines. A concrete lower floor is in any case required by the Alcohol Tax Unit of the Treasury Department to prevent theft by tunneling.

Since repeal of the Prohibition Amendment we have added nine new and reconditioned bottling plants, about 400,000 barrels of new storage capacity, and have built or reconditioned nine distilleries, one gin plant and numerous old warehouses and other buildings. The design and construction of all this work was handled by Sanderson & Porter, of New York City.

Corner in the rack house showing solid floor and sprinkler system above

Vinyl Resin Fiber

EDITORIAL STAFF SUMMARY

A PATENT, No. 2,161,766, covering a synthetic fiber made from vinyl resins was issued on June 6, 1939, to the Carbide & Carbon Chemicals Corp. by the U. S. Patent Office.

Briefly, the fibers are formed by spinning a solution or dispersion of the vinyl resin into filaments. These filaments are formed into fibers of the desired size by twisting and doubling operations as desired, and thereafter the fibers are stretched to yield products suitable for use in the customary textile operations. The stretching of the fibers is carried out while they are in their normal state, by which is meant that they are not softened by heat or by the action of a solvent. This stretching operation is a vital feature in the production of useful textile fibers from the vinyl resins, and it serves the dual purpose of greatly increasing the tensile strength and of conferring on the fibers the unusual and highly desirable property of true elasticity. By means of the stretching operation, the two highly important properties of tenacity and elongation may be varied and controlled almost at will.

The fibers in finished form are soft and flexible and are characterized by their ability to be woven and knitted and formed into a large number of exceptionally useful materials. The new fibers possess a very high strength by comparison with other textile fibers, and they are unusual in that their strength is virtually the same whether they are wet or dry, and, surprisingly enough, the wet strength of the new fibers is, if anything, slightly greater than the dry strength. The unique resistance to impairment by water, together with the true elasticity, resistance to chemical, bacterial and fungal attack, thermoplasticity, lack of flammability and great flexibility of the fibers, makes possible many uses for these materials which are radically different from those to which ordinary textile fibers are applicable.

As has been indicated, the vinyl resins from which the new fibers are prepared must have special characteristics. The class of resins useful in this invention are those such as are described in Patent 1,935,577 to E. W. Reid, and these resins may be made by the processes described by that patent or by other means, such as the process described in Patent 2,064,565 to E. W. Reid. Of these conjoint polymers of vinyl halides with vinyl esters of aliphatic acids, the preferred resins are those which contain some 80 to 95 per cent by weight of halide in the polymer. Within this range, those resins formed from vinyl chloride and vinyl acetate which contain in the polymer about 85 per cent to 90 per cent by weight of the chloride are especially desirable.

The resin must have an average macromolecular weight of at least 15,000, and the upper value is limited only by the solubility of the resins in suitable liquids to yield spinnable solutions or dispersions. Vinyl resins, as prepared ordinarily, consist of a mixture of polymeric aggregates of different molecular sizes. Those to be used in this invention should be free from polymers having excessively low molecular weights in order that the average macromolecular weight of the resin will be at least the minimum stated above. This may be accomplished by various extraction procedures such as those described in Patent 1,990,685 to C. O. Young and S. D. Douglas, or by similar methods of partial dissolution and precipitation of the desired polymer mixture.

Unloading Liquid Caustic

Like most chemicals, caustic soda and caustic potash require a special handling technique for unloading from steel tank cars. A discussion of the precautions to be observed, facilities required and recommended practice is presented here.

RECENTLY the Manufacturing Chemists' Association published a manual sheet (No. TC-3) setting forth its newly adopted recommended practice for unloading tank cars filled with liquid caustic. Because of space limitations, we are able to present this valuable and practical information in abstract form only. However, the complete report is available from the M.C.A. Secretary, 608 Woodward Bldg., Washington, D. C., for the nominal price of ten cents per copy.—Editor.

IT IS COMMON KNOWLEDGE that caustic soda and caustic potash are strong alkalis. In contact with the skin they produce serious burns. They also attack wool and leather quite rapidly. Therefore, it is imperative that the unloader of the caustic tank car take certain precautions in order to prevent damage to persons and property.

Precautions should start with the spotting of the tank car on the siding. After setting the brakes and blocking the wheels, the workman should place "Stop" signs before and behind the car as provided by the I.C.C. He should also stretch a safety rope completely around the car to keep unwary persons from coming too close.

Certain safety rules should be observed by the workmen before the unloading is started. They should wear rubber-covered canvas gloves (with shirt-sleeves rolled down over wristlets) and close-fitting goggles. Clothing recommended is as follows: hat, cotton overalls, rubber apron and rubber booties (tops of booties go inside trousers).

Water in ample quantity must be immediately available at the unloading rack. A shower-bath provided with a treadle valve is recommended. Should caustic contact the skin, wash off immediately with a large amount of water. Eye injuries should be thoroughly treated with running water and a physician called immediately.

The following miscellaneous rules concern details, but are important: (1) Contents of car tank should be discharged only in the daytime or when adequate lighting is provided. (2) If it is necessary to move tank car after part of caustic content has been unloaded, replace all closures securely. (3) Unloader must not leave car during the unloading operation. (4) Make sure that the tank storage will hold the contents of car and that the storage is vented before connecting the unloading line.

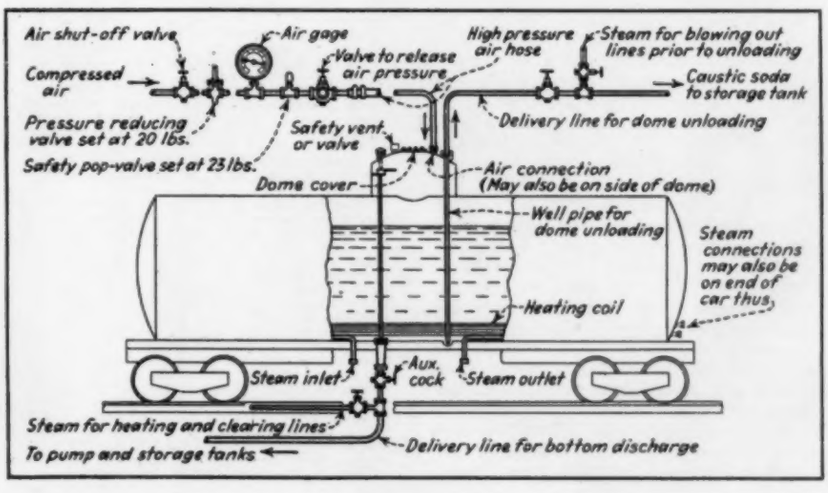
Steaming Caustic—Standard 50 per cent liquid caustic soda solidifies at a temperature of approximately 55 deg. F. or below, while the 70 per cent grade crystallizes at about 149 deg. F. Shipments of liquid caustic potash do not differ markedly from liquid caustic soda and the same directions will therefore apply to both products. To determine whether steaming is necessary, open the dome cover after internal car pressure has been relieved and insert a rubber-capped, long iron rod down through the liquor to the car bottom and along the sides. The "feel" of contact will indicate the presence of crystals and necessity of steaming. Should a layer of solid caustic be formed over the top of the content within the dome, this crust should be punctured before admitting steam to the heating coil so as to permit liquid expansion as heating progresses. It is advisable during cold weather, especially when there is a high velocity wind, to cover the tank car (if uninsulated) with tarpaulins or other protecting media, as the loss of heat under such conditions may seriously prolong the melting time.

Detailed instructions for steaming 50 per cent caustic are as follows:

1. Equalize car pressure with atmosphere by opening dome air connection. Certain cars have the air connection on top of the dome, others on the side of the dome. In case the car is not equipped with such air connection, carefully unbolt and open the dome cover. Puncture top crust of solid caustic, if any.
2. Make steam connections at heater coil pipes. See drawing.
3. Steam pressure should be built up gradually to avoid rupture of heating coil. Care must be exercised not to heat the contents to the point where expansion results in the valve rod handle being covered or where liquor overflows the dome. Heat only until caustic is completely liquefied. Temperature of liquor should never exceed 100 deg. F. in the case of lined cars. Never introduce water directly into a lined car containing 50 per cent caustic liquor.

A slightly different technique is required for handling 70 per cent caustic. Tank cars handling this material are usually insulated to conserve heat, because even in warm weather, a certain amount of heating is usually required. For complete melting under average conditions without addition of

Diagram showing the tank-car connections which must be used for unloading liquid caustic


Air shut-off valve
Air gage
Valve to release air pressure
High pressure air hose
Steam for blowing out lines prior to unloading
Compressed air
Caustic soda to storage tank
Pressure reducing valve set at 20 lbs.
Safety vent or valve
Delivery line for dome unloading
Safety pop-valve set at 23 lbs.
Air connection (May also be on side of dome)
Dome cover
Well pipe for dome unloading
Steam connections may also be on end of car thus,
Heating coil
Steam inlet
Aux. cock
Steam outlet
Steam for heating and clearing lines
To pump and storage tanks
Delivery line for bottom discharge

water or live steam within the car, approximately 18 to 36 hours steaming will be required at 50 lb. steam pressure. This pressure should never be exceeded. Detailed instructions for steaming 70 per cent caustic are as follows:

1. *Without dilution*—Heat contents to 194 deg. F. or slightly higher before attempting transfer to storage tank. Unloading lines must be preheated before unloading. This may be done by blowing with steam. It is advisable, however, that pipelines be provided with parallel steam lines, the two being in close contact and wrapped together with insulating material. If a parallel steam line is not practicable, it is advisable that unloading line be jacketed so as to conserve heat.

2. *With dilution*—Dilution of 70 per cent caustic is often recommended to facilitate unloading and to lessen steaming time. Live steam may be introduced directly into the liquor within a car. Introduction of a metered quantity of hot water within the car will materially hasten melting. If dilution at time of unloading is contemplated, it is recommended that shipper be consulted, both as to dilution methods and correct sampling.

Methods of Unloading

Tank cars containing caustic may be unloaded through the dome by means of an eduction pipe extending to the bottom of the tank, or through bottom discharge outlets. Where the car is equipped with an eduction pipe, dome unloading may be accomplished by means of air pressure. For bottom unloading, the liquor may flow by gravity to a pump or directly to the storage tank with or without the aid of air pressure. It is important that the details of unloading be carried out strictly in the order mentioned in the following paragraph.

Dome Unloading by Air Pressure[1]—After the dome cover has been replaced securely (air-tight), remove the protective housings from the air inlet and from the dome discharge fitting. Connect the unloading line (flexible steel or standard pipe with swivel joints) to dome discharge connection. Then connect air supply lines (high pressure hose or standard pipe) to air inlet on top or side of dome. The line should be equipped with release valve, safety pop valve set at 23 lb., pressure gage, pressure reducing valve set at 20 lb., and air shut-off valve. These valves should be of iron or iron and Monel trim construction.

Air pressure should then be applied slowly until there is a normal flow of liquor to the storage tank. Adjust air pressure and maintain until car tank is completely empty. A drop in pressure and a sound of air rushing through the discharge pipe indicates that the car tank is empty. Continue air flow until the unloading line is completely empty, then shut off air, open release valve, and allow discharge pipe to drain. Disconnect plant air fittings from air inlet on car and close inlet cock. Do not disconnect unloading line until car tank is at atmospheric pressure and unloading line thoroughly drained. Disconnect unloading line from discharge pipe fittings and replace cap or plug tightly, taking care that drainage does not spill on the car. If there is accidental spillage, wash off immediately with water to protect trainmen handling the empty car on its return and to minimize car damage.

A final precaution is: When inspecting the car to determine whether it is empty, do not use an open flame as a source of light, since an explosive mixture consisting of hydrogen and oxygen may be present. Protect face, eyes and neck from caustic mist.

Unloading Through Bottom—Bottom unloading may be accomplished in any of several ways—by gravity flow, by pumping, with the use of air pressure, or with a steam syphon. However, the same general rules apply in all cases. The steam syphon method can, of course, be used only where dilution of the caustic is not objectionable. Detailed instructions for unloading through the bottom are as follows:

Make sure the bottom discharge outlet is thoroughly heated. This may be accomplished by connecting to a steam line by means of a short nipple and tee directly beneath the auxiliary cock. (See cut). If the discharge line is entirely plugged with solidified caustic, heat is best applied on the outside of the line by wrapping with rags and then applying steam from an open steam line. Next, remove the dome cover and leave open during unloading. Also remove cap or plug from the bottom of outlet chamber leg under car.[2]

Now the unloading line may be attached. Then return to dome and open bottom outlet valve by turning the valve rod handle. If the outlet valve handle or wheel does not move with a light pressure, it indicates that frozen material still remains in the bottom of the car and that further steaming is necessary. Do not attempt to force the valve open as this may break it and make bottom unloading impossible. The valve handle may be located within the dome, or the rod may extend through the dome shell to the outside. In the latter case, examination of the dome will disclose the valve rod handle or removable cap, which on being removed and inverted becomes an operating hand-wheel when fitted back on the valve rod. If the valve handle is inside the dome, the operator should protect face and head by holding to one side while operating the valve, thus avoiding possible splashing with caustic liquor. The final step is to open the auxiliary cock, if the car is so equipped and allow the contents to flow to the storage tank.

Preparation of Empty Car for Return—After blowing out the unloading line with steam followed by air, close the bottom outlet valve, then disconnect and securely replace the bottom outlet plug or cap. In this operation care must be exercised to avoid caustic spattering. The steam lines are then disconnected and blown out with compressed air. Do not replace the caps on the inlet and outlet connections; merely let them hang by their chains. If the car is equipped with valves at each point, leave the valves open. After removing the connection, replace closures on all other tank openings. Close and securely fasten the dome cover.

Materials and Equipment—Use wrought iron, steel or cast iron pipe. No copper, brass, bronze or aluminum should be allowed to come in contact with liquid caustic. Caustic solutions at ordinary temperatures have little effect upon iron. At elevated temperatures the iron pick-up, although small, becomes more appreciable. Certain alloys are resistant to such action.

Flange joints throughout the piping installation are preferable to screw connections. Couplings do not hold up well in caustic service. It is advisable that as few joints as possible be used in the unloading line.

Single suction, non-airbinding type of centrifugal pump, with extra deep stuffing box is recommended. Avoid extra-close coupling between pump and motor. It is advisable that the pump be fabricated of nickel cast iron and be provided with facilities for easy draining and steaming, and that graphitized asbestos packing and a Monel shaft be used.

One final word of instruction is: Under no circumstances should the consignee attempt to enter the car. Any internal washing should be done in accordance with the shipper's instructions. In the event that a tank car is received with evidence of a leak or splashing through one of the dome fittings, the consignee should make repairs sufficient to unload the content. In every case the shipper should be given full particulars.

[1] When compressed air is used for discharge of lading, it is important that all dome fittings be inspected for evidence of leaks or other defects before unloading and thus avoid possible caustic spray after tank is subjected to air pressure. Should leakage occur, particularly at dome fittings, unloading operation should be suspended and reported to the supervisor for advice on further procedure. It is advisable that the air supply line be provided with an oil trap.

[2] Bottom plug is generally screwed to an auxiliary valve which is attached to outlet chamber. Many cars are so equipped. In case there is no auxiliary cock and plug is screwed directly into bottom outlet chamber fittings, a pail should be placed in position to catch any liquid that may have leaked passed the outlet valve. If leakage showed upon starting removal of plug, plug should not be entirely removed, but sufficient threads should be left engaged and sufficient time allowed to permit drainage of any accumulation of liquids from discharge outlet before taking out plug entirely. If leakage persists, showing that outlet valve is not properly seated, valve rod handle should be turned several times in both directions in an effort to reseat the valve. Care must be exercised to avoid being spattered by caustic.

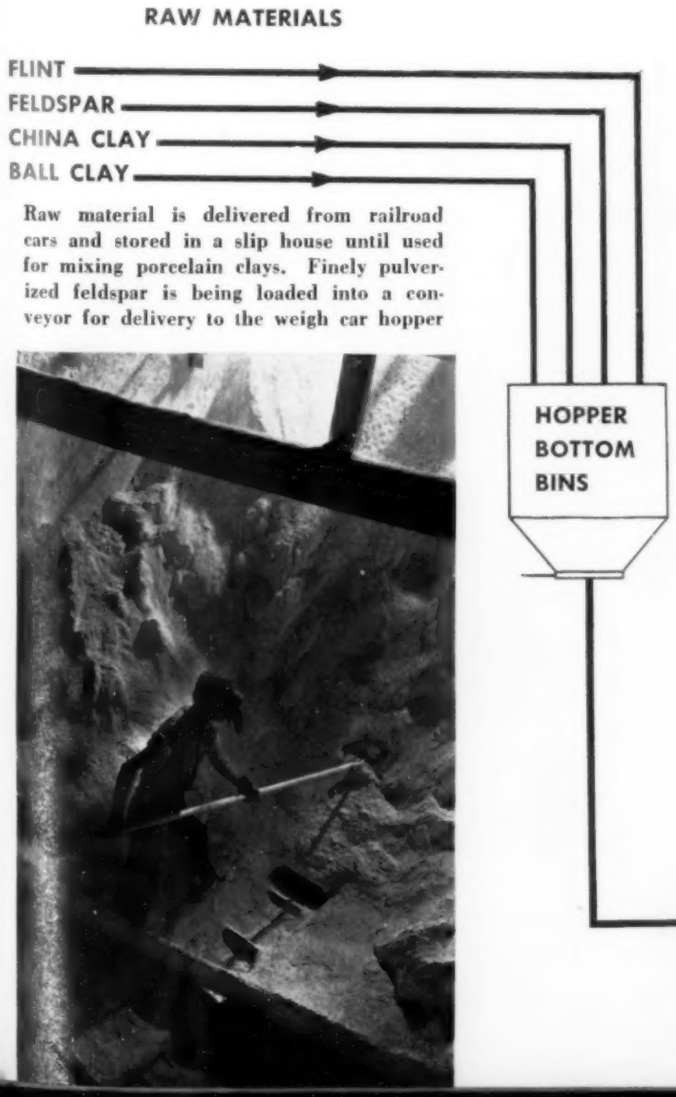
Wet Processed Porcelain

MANUFACTURE of porcelain is one of the oldest of industrial arts, but with the advent of electricity, its properties as an insulator added another and important function to a list that ran the gamut from tea cups to decorative tiles. Today there are few people indeed in the United States who do not depend in some measure on porcelain for the necessities of life.

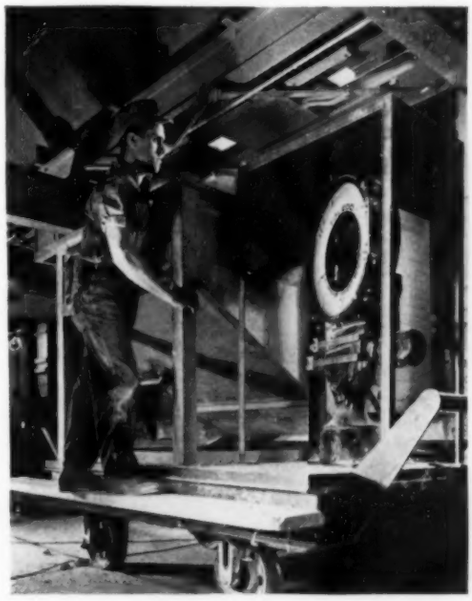
Some 20 years ago, the Westinghouse Electric & Manufacturing Co. recognized the importance of porcelain manufacture and purchased a porcelain manufacturing plant. Since that time, all the research, engineering, and manufacturing skill at the company's command have been brought to the production of this product. As a result, the manufacture of porcelain has developed many of the attributes of an exact science and lost some of the romantic characteristics of a hereditary art.

In the plant at Derry, Pa., Westinghouse produces thousands of various sizes, shapes, and types of porcelain used in its apparatus and the electrical trade at large. The processes employed in this plant are typical of those used in other electrical porcelain plants.

In this and in most other modern electrical porcelain factories, there are three lines of production flow: wet-process porcelain, dry-process porcelain, and cast porcelain. The first method is used for the production of fine-grained highly glazed insulators for high-voltage service; the second is used for rapid production of more open-textured low-voltage pieces; and the third for forming pieces too large or too intricate to be made by either of the other methods. The same raw materials are used for all three processes, the only fundamental differences being in drying and forming. Essential steps in the manufacture of wet-process porcelain are illustrated here by both diagrams and pictures of the various operations.

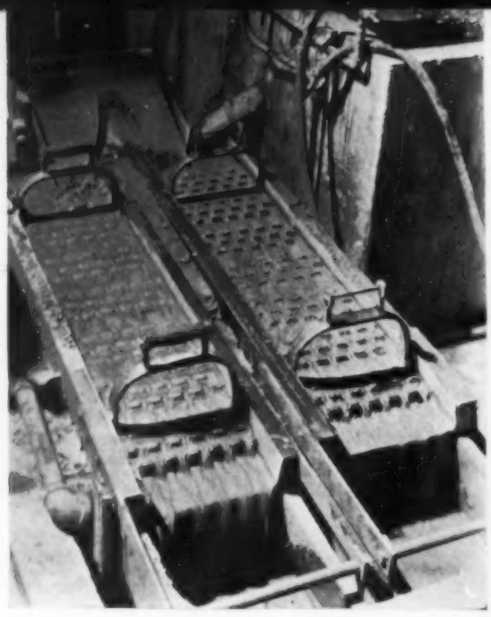


Raw material is delivered from railroad cars and stored in a slip house until used for mixing porcelain clays. Finely pulverized feldspar is being loaded into a conveyor for delivery to the weigh car hopper

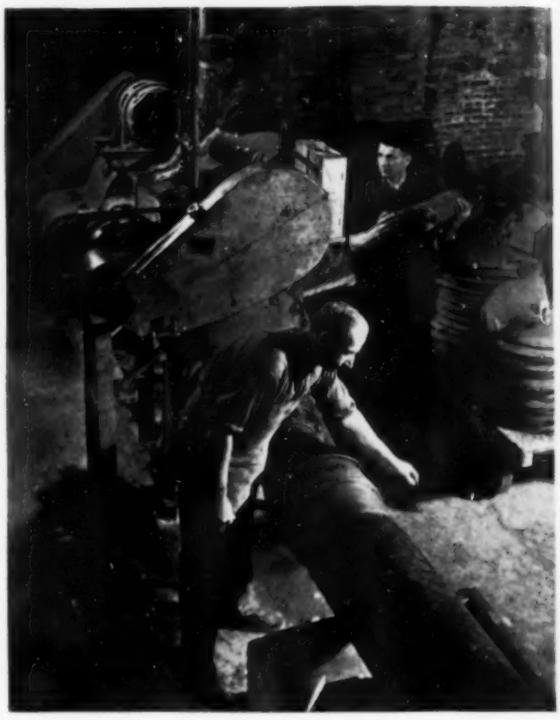


Domestic materials are used whenever possible. The ingredients for porcelain are carefully weighed for each batch of mix as the raw materials flow from an overhead hopper into the weighing car

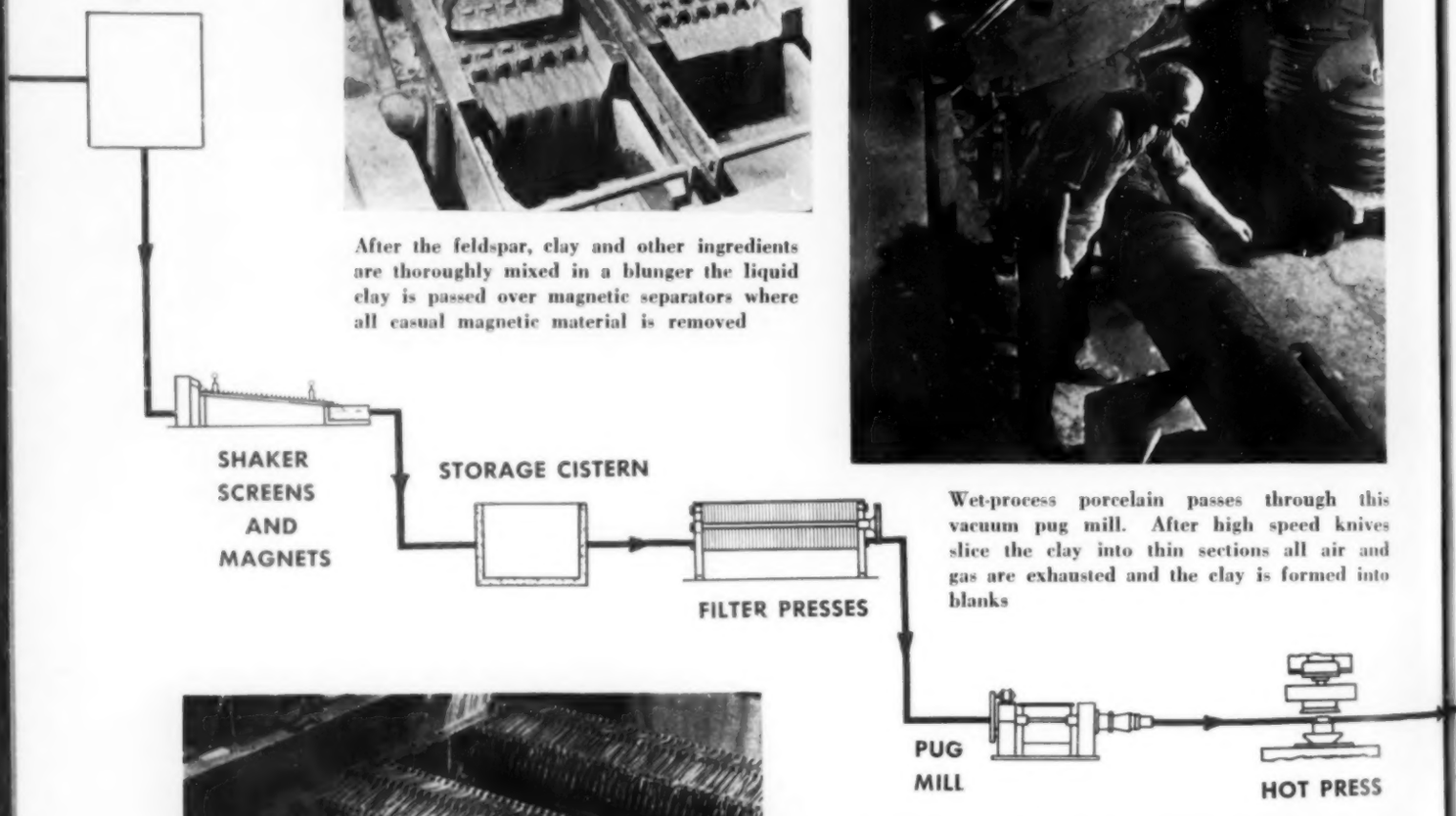
A Chem & Met PICTURED FLOW SHEET



After the feldspar, clay and other ingredients are thoroughly mixed in a blunger the liquid clay is passed over magnetic separators where all casual magnetic material is removed



Wet-process porcelain passes through this vacuum pug mill. After high speed knives slice the clay into thin sections all air and gas are exhausted and the clay is formed into blanks

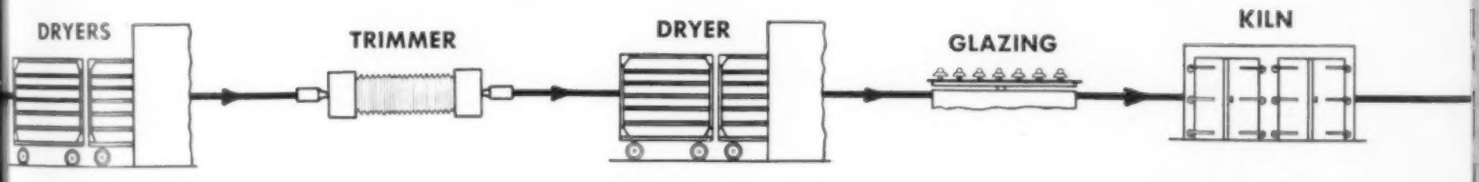


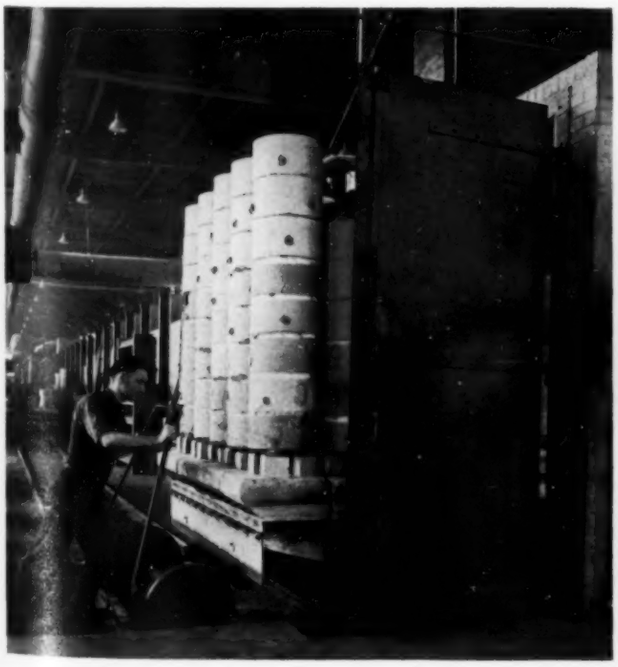
About 68 per cent of the water is eliminated by the filter presses through which pass both wet and dry process porcelain mix

Hot pressing porcelain. Plastic clay is kneaded by the workman in the background to eliminate possible internal stress. A talc treated conical mold holds the clay

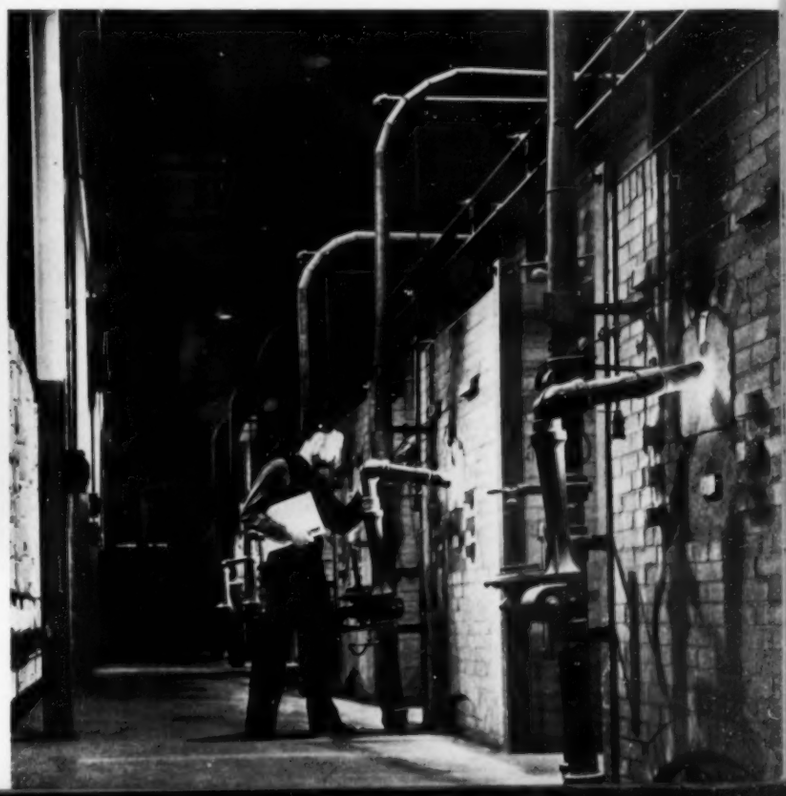
The finest glazes are used in the hand dipping operation being performed by the man in foreground. This glaze gives a final finish with high luster

Drying conditions are closely controlled within both preliminary and final drying oven. Experts watch closely speed of cars, air conditions and temperature



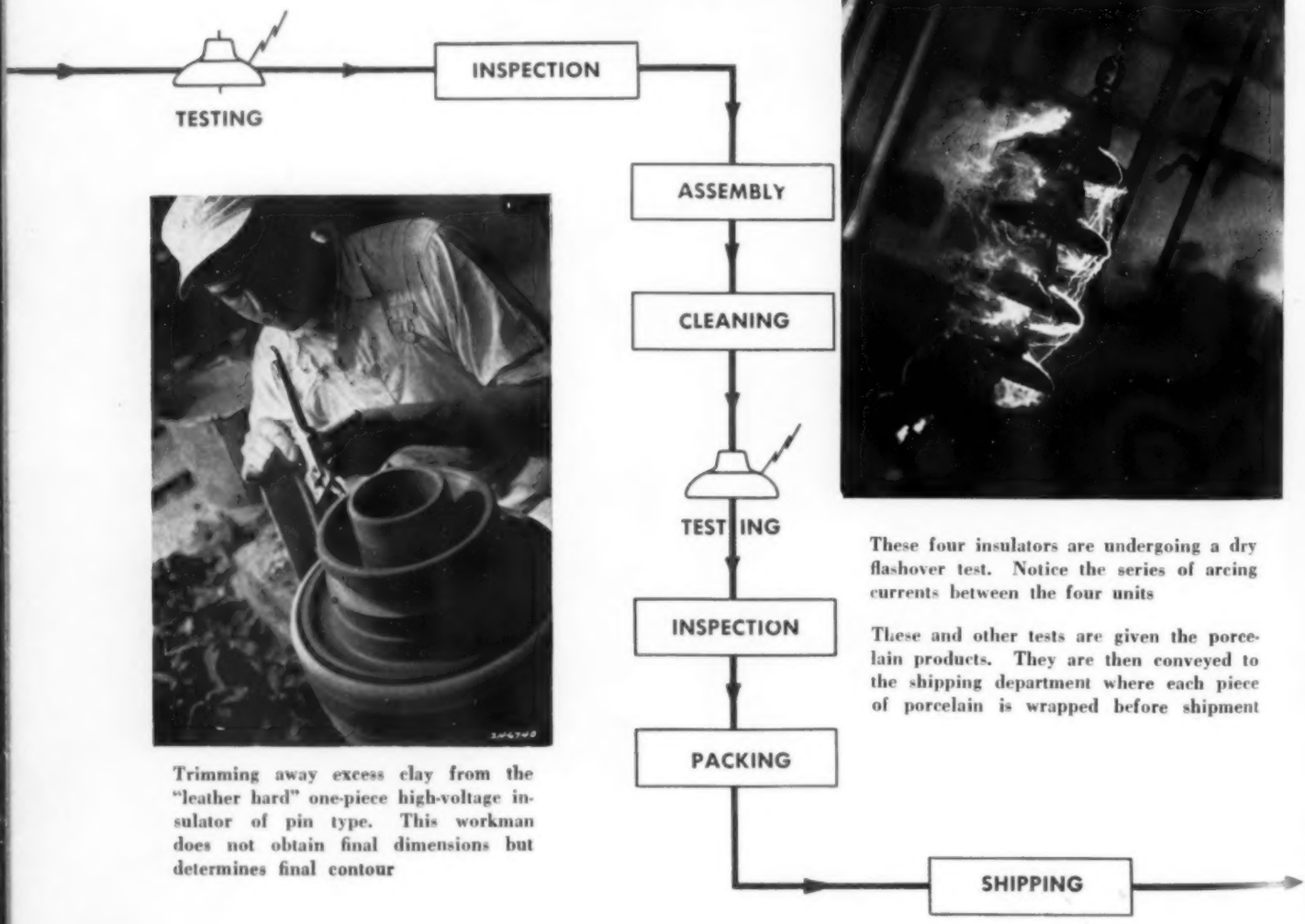


Hydraulic rams determine speed at which ware cars travel through this great kiln. Temperature inside the kiln is controlled within rigid limits



Wet process porcelain pieces are subjected to a high frequency high-voltage test far in excess of normal requirements. In this illustration they are undergoing full AIEE 60-cycle flashover test

Before final cementing and assembling, pin type insulators are given a rigorous inspection for flaws



Trimming away excess clay from the "leather hard" one-piece high-voltage insulator of pin type. This workman does not obtain final dimensions but determines final contour

These four insulators are undergoing a dry flashover test. Notice the series of arcing currents between the four units

These and other tests are given the porcelain products. They are then conveyed to the shipping department where each piece of porcelain is wrapped before shipment

X-Ray Weld Inspection in the Field

Because such chemical equipment as high-pressure pipes must often be welded on the job, it is important that a reliable method of inspection be available. A portable X-ray machine has been developed to satisfy this need.

H. R. ISENBURGER
President
St. John X-Ray Service, Inc.
Long Island City, N. Y.

SIX YEARS AGO the author informed *Chem & Met.* readers of the advantages of radiographic methods of weld inspection. (See *Chem. & Met.* for March, 1933, pp. 130–32). In the light of more recent developments it seems advisable to amplify that material by describing the present-day method of inspecting welds on the job and in the field.

The important development in this field is a portable X-ray unit that is mounted on a trailer chassis and used to inspect welded pipes in the field. With the advent of higher and higher pressures and temperatures, which now range up to 2,500 lb. per sq.in. and 1,000 deg. F., the necessity for good joints has become increasingly important.

How the Machine Works

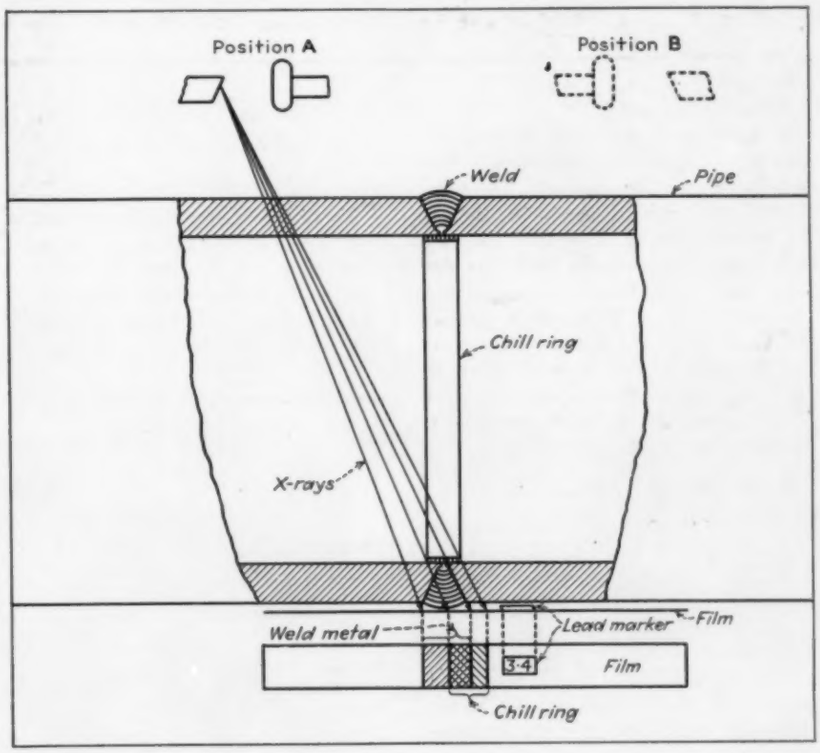
For those who are not familiar with the former article, a brief explanation of how an X-ray joint inspector works will be given: A lead-backed film holder is attached to one side of the weld and the X-ray tube is placed on the other. Intensity of radiation through holes, slag and other defects is greater than through the denser weld metal, thus imposing a greater exposure on the film in some places than in others. Then the projector is displaced and another shot taken. By comparing the resulting "exographs," i.e., X-ray photographs, the magnitude and location of the impurity may be calculated. Then the weld may be chipped out and repaired if the imperfection is serious enough.

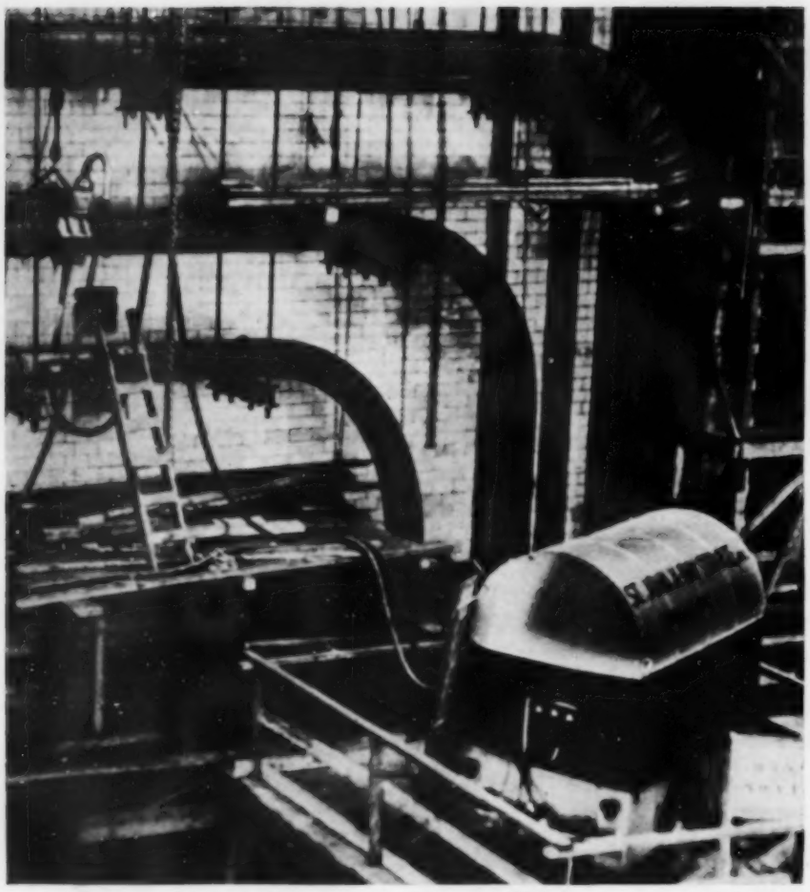
The examination of pipe welds, however, is not quite so simple. In field work especially, it is impractical to place the film inside the pipe and it is impossible to place the X-ray tube in the pipe. To overcome this difficulty a new technique has been developed. As shown in the accompanying diagram, the rays are projected on an angle so that only the part of the weld directly in contact with the film shows up on the exograph. By this procedure, it is necessary to rotate the X-ray machine, taking two shots at each setting (one in position *A*, the other in position *B*). For a 12 in. pipe, six settings are usually required.

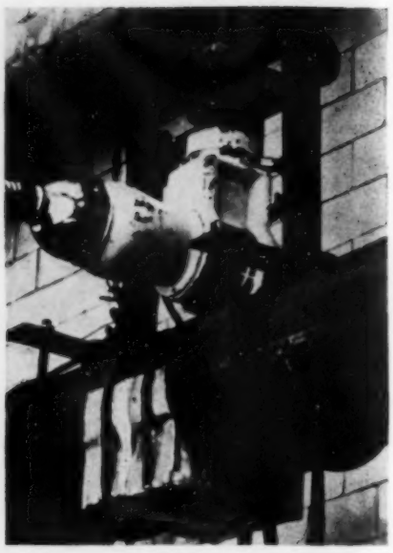
Accompanying halftones show the positioning of the small unit on a pipe and also a plant view of the trailer machine at work.

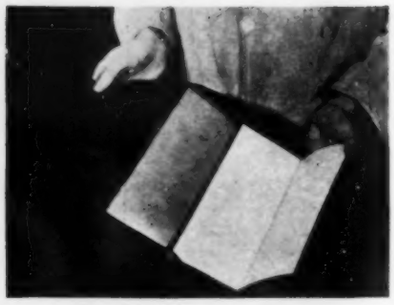
Some of the features of the portable X-ray machine are as follows: It has a 220 kv.-10 milliamp. X-ray tube, requires a 220 volt–60 cycle a.c. line to

To avoid "exographing" both sides of a circumferential weld in one exposure, the X-ray tube is displaced to one side. A second exposure is then taken from position *B*. By comparing the two films the defect is located









Thirty-foot flexible cables connect the portable X-ray tube to a trailer housing a transformer, rectifier and other equipment. In addition to the current conductor, the anode cable contains two concentric hoses for the circulation of cooling water. Top Right—X-ray tube and film holder set up on a pipe in the proper position for "exographing." Bottom Right—Flexible film folder with intensifying screens. This folder fits inside the lead covering shown in the view above

operate it. However, it may also be operated by a gasoline engine—the motor of the automobile that pulls the trailer being quite adequate. The tube is equipped with a water-cooled target, to which water is circulated through the high tension anode cable. Its design permits line focus and so assures perfect definition. This unit is capable of X-raying a 3-in. thickness of steel in an exposure of one minute, owing to the use of a special electron grid which filters the radiation, practically doubling its penetrating effect.

Cost Considerations

Another interesting consideration is the cost of this X-ray inspection service. The service crew incudes three men—the technician, his assistant and a rigger. They can inspect welds just twice as fast as the welds are made. Much of their time is consumed in moving the equipment, but under favorable conditions they can examine two 12-in. joints or five 8-in. joints in an 8-hr. day.

Case Study in Costs

Perhaps the best insight into actual cost would be to take a case in point. One plant job involved 112 different size field welded joints and required the X-raying of 137 joints as shown in the accompanying table. Inspection, materials and repairs amounted to $11,371 or $83 per joint. This cost was high due to the fact that 28 per cent repairs were necessary. Ordinarily 10 per cent is a fair average for repair work. This job required three months time and 1,310 exographs before completion. Pipe sizes varied from 8 in. in the boiler feed and 12 in. in the main steam line to 24 in. in the bleed line.

Data on Power Plant Weld Inspection Job

	Main Steam Line	Boiler Feed Line	200 lb. Bleed Line	Tot'l
Welds X-rayed ..	33	65	14	112
Completely repaired	1	2	1	...
Partly repaired...	7	11	2	...
Repaired twice....	1	...	...	...
Repaired without re-examination..	...	...	2	...
Total welds repaired	9	13	3	25
Total Joints X-rayed				137

Field of Application

The same portable equipment and similar technique can be applied to many field inspection jobs. Some of the more prominent applications are the inspection of airplanes, ships, bridge and building structures, welded and riveted tanks in the oilfields, gas works, paper digesters and the like. There is no doubt that when properly applied, X-rays offer a means to prove the soundness of a material and this machine widens their field of application.

Capitalizing on Chemical History

In staging a dramatic celebration of eighty years of baking powder history, Rumford Chemical Works was afforded an opportunity to review and strengthen its close relations to the local community, to its plant employees and to an interested public.

ALBERT E. MARSHALL
President
Rumford Chemical Works,
Rumford, R. I.

TO ONE WHO HAS long nurtured a hobby interest in chemical and engineering history, the events that occurred in Rumford, R. I., June 23, 1939, proved a source of much personal pleasure and gratification. It was the writer's privilege that day to participate in the dedication of a new museum of early chemical and industrial equipment, to assist in the unveiling of a bronze bust of a great pioneer scientist and to have a part in publicly reviewing the accomplishments of an American chemical company after nearly a century of service to its community and public. This article is written, however, primarily because the editor of *Chem. & Met.* believes that a recital of these events and the circumstances and philosophy underlying them might encourage a greater interest in historical matters on the part of other chemical companies.

In 1854 Professor Eben N. Horsford, who occupied the Rumford Chair for the Application of Science to the Useful Arts at Harvard, was approached by George F. Wilson with the proposal of a business partnership. Together they leased a small plant in Pleasant Valley, which is now within the confines of the city of Providence, R. I. Succeeding almost from the very beginning, four years later they pur-

Helen Wilson's sketches of the plant in 1859

As Rumford Chemical Works appeared in 1869

And the modern Baking Powder Plant of 1939

Rumford's first building and laboratory built in 1859 at Seekonk, Mass., was dedicated June 23, 1939 as a Museum of Early Chemical and Industrial Equipment

Assisted by two of Rumford's veteran employees, Jeremiah Mountain and Lester Scudder, "Count Rumford" (Theodore Sweet) unveils his own statue

The "Count" and the author discuss two centuries of chemical progress in the presence of the former's sculptured portrait by Mlle. Suzanne Silvercruys

chased a much larger site and built their own factory and laboratory in what was then Seekonk, Mass., but which later became East Providence, R. I. Their purpose, they set forth formally, was "*building up a chemical manufacturing establishment of respectability and permanency, such as shall be an honor to ourselves and our children and a credit to the community in which it is located.*" The records of the past 85 years show how well they succeeded.

"The principal manufacture," says an account written in the early days of the company, "is that of pulverulent phosphoric acid, commonly known as 'Horsford's Cream of Tartar Substitute' for bread-raising. In the invention of this chemical, the main desire was to avoid all fermentation and to give to bread made of bolted flour a 'deficient' ingredient which would add to the nutritious quality of the bread." It reached its successful conclusion in 1859 when the young company put on the market the first calcium phosphate baking powder.

In 1859 there were very few chemical factories in the United States. The Census returns for 1860 give a total value of domestic chemical production of $4,700,000—a figure which is less than the value of a single week's production in 1939.

The products of the American chemical industry of 1859 were the industrial used acids, some soda, potash and ammonia salts, a few mercury, copper, tin and iron compounds, and inorganic colors. The equipment employed was either a copy of European apparatus or ingenious makeshifts devised by manufacturers who had to rely on their own and their mechanics' abilities to overcome the difficulties of constructing equipment capable of meeting the corrosive action of acids and alkalis.

Most of the strivings of these men and of the still earlier founders of the American chemical industry has, unfortunately, gone unrecorded. There are all too few existing examples of the equipment they worked with in their efforts to match the products which came in from Europe.

Fortunately, the founders of Rumford chose a large factory site and as the property continued in family ownership from one generation to the next, some of the older buildings and equipment, long abandoned, were permitted to reside alongside of their modern successors. One of these buildings was the original small plant built in 1858, which is shown in an accompanying sketch by Helen Wilson, a great-granddaughter of one of the founders and daughter of the late Ellery L. Wilson. It originally housed the laboratory of Professor Horsford, the office of George F. Wilson and the manufacturing operations, which in 1859 included the world's first production of an all-phosphate baking powder.

In the 80 years since then, this little building served many purposes. Fortunately it was of sturdy New England construction and when we decided to convert it into a museum, it capably withstood a 400-yd. transfer to the new site alongside of the modern five-story baking powder plant. In it are being put all of the original apparatus which has been preserved, together with the tools of the craftsmen of that day, because even a small plant had to maintain its own carpenters, wheelwright, blacksmith and machinist. We are going to rebuild missing parts of the phosphate and other units as shown in the 1859 inventory records and drawings still available, all to the end that there will be preserved here a visible record of the beginnings of the two branches of Rumford's modern business—baking powder and chemicals.

This building was officially dedicated as "Rumford Museum" on June 23 with an appropriate address by Dr. Henry M. Wriston, president of Brown University, which institution had been benefited in 1891 by a gift of $100,000, that had built and equipped the Wil-

son Hall of Physics. An amusing part of the ceremony which demonstrated the efficacy and raising power of baking powder, was the use of a single teaspoonful of this material to open the old sliding door of the museum. The CO_2 generated by the action of the water raised a float that completed an electric circuit while an unseen electric motor quietly operated the door-opening mechanism.

Following the dedication of the museum, our many guests witnessed the unveiling of a bronze bust of Benjamin Thompson, Count Rumford—the distinguished 18th century scientist from whom both the chemical company and its community received their name. Master of ceremonies on this occasion was Paul R. Ladd, Chief Crier of the Town Criers of Rhode Island and the speakers included the noted sculptress, Mlle. Suzanne Silvercruys of New York and Arthur H. Linscott, president of the Rumford Historical Association of Woburn, Mass. Just as the unveiling was to be done by two of the company's veteran employees, Jeremiah Mountain of the Chemical Plant and Lester Scudder of the Baking Powder Plant (who had been elected by their fellow workers to represent their respective departments), there was a sound of fife and drums. It announced the approach in a one-horse carriage of none other than Count Rumford himself (impersonated by Theodore Sweet, one of Rumford's district sales managers and the son of the former board chairman, William L. Sweet). In the course of his remarks, the "Count" insisted on quoting from an essay he had written a century and a half ago. These are the words:

"'I feel deeply that all that a single individual can effect by his own labours during the course of his short life, in extending the vast domain of science, is, unfortunately, a very small matter. It is only by the simultaneous efforts of a large number of men and women, with good heads and skilled hands that we can hope to see a sensible advance of this great enterprise, of which men will never see the completion.'"

"Because you two gentlemen are representatives of the larger number of your associates of good heads and skilled hands, I am proud to assist you today. Will you permit me to place my hands beside yours as you unveil this statue? And will you permit me, as it appears, to remind you again that this great enterprise (indicating the modern factory buildings) advances only through the cooperation of a large number of men and women, with good heads and with skilled hands."

Prominently represented at the unveiling were all of the employees of the company, many of the local citizens and a number of out-of-town guests representing supplier* and customer groups and the editors of trade and technical publications. The guests were then entertained at the Squantum Association and served an all-Rhode Island dinner, the menu for which had been selected by popular vote of the women of the State. The versatile "Count Rumford" who in his day had contributed so much to the sciences and arts, was then introduced to the radio and proceeded to interview, in a humorous vein, some of the distinguished guests including Governor William H. Vanderbilt and Mlle. Silvercruys.

On this occasion it was the writer's privilege to broadcast in a somewhat more serious vein these words:

"Today's celebration, however, means something more to us than paying respect to an inspiring past and dedicating to the public use a museum wherein we shall arrange reminders of the vanished industrial era.

"We live and have our being in the world of today, an exciting world in which the applications of modern science bring forth a succession of new developments, new processes and new products. Science is ever youthful, for its hall-mark is energy—whether it be the chemical energy we utilize in reactions, the electrical energy which provides brute power for our operations and the infinitely delicate control for our measuring instruments, or that newest form we have not yet harnessed—the energy locked in atoms.

"If our choice of a profession was along scientific lines, and the business we are engaged in has the science of chemistry as its background, then we must stay young in our approach to each day's problems—the past will not provide us with answers, for science progresses at an ever increasing pace, each new discovery sug-

*Of considerable significance is the fact that Rumford began buying its sodium bicarbonate from Church & Dwight in 1862—77 years ago. And they still keep it up. Likewise Rumford has bought its starch from Corn Products Refining Co. ever since 1884—A.E.M.

Rumford Museum and the statue of Count Rumford as they appear in relation to the baking powder plant. Chemical manufacturing units are barely visible in the background

President Marshall discusses his museum plans with a group of Rumford employees who participated in the dedication ceremonies on June 23, 1939

Although pensioned in July, 1938, Mary E. Powley comes in one day a week to the baking powder plant where she started to work in 1879 as a mere slip of a girl

gesting a new line of research and a new goal.

"So, we of Rumford are constantly endeavoring through chemical and engineering research to improve on the familiar ways of doing things, to develop better methods for the precise control of operations and quality, and to discover new products which will have the practical merit of usefulness."

These events, which are better chronicled in some of the accompanying photographs, are cited here merely to show one of the ways in which a chemical company can draw upon its historical background in telling its story to an interested public. The stimulating effect on plant personnel and on the attitude of the local community are most important byproducts.

When a technical, highly skilled operation is maintained in any community over many years, there grows up a body of especially skilled men and women. This is true of furniture in Grand Rapids, glass in Corning, steel in Pittsburgh, hats in Danbury. It is true of Rumford, R. I. Many men and women in the Rumford Chemical Works inherited their skill from parents, grandparents, or great-grandparents who preceded them in the company. All know the pride of their crafts. We in Rumford are proud of the fact that 56 of the men and women who make Rumford baking powder are of the second, third or fourth generations in the ranks of the company.

Life affords few satisfactions keener to all concerned than the sense of unity of many people working closely together to one clear purpose. In the making of things, this brings reward to the community, the company, the product—and satisfaction to the product's millions of patrons throughout the world.

Rumford employees are proud of the fact that fifty-six of the men and women who make baking powder are second, third or fourth generation in the ranks of the company

Chemical Engineer's BOOKSHELF

New Titles, Editions and Authors

DYEING AND DYESTUFFS

DYEING WITH THE COAL TAR DYESTUFFS by *C. M. Whittaker* and *C. C. Wilcock*. Published by D. Van Nostrand Co., New York, N. Y. 326 pages. Price $5.

Reviewed by *W. L. Abramowitz*

IN THESE DAYS of free technical service and excellent instructive pamphlets offered by the various dyestuff manufacturers, a volume on dyeing has to be the "real Perkins" (to paraphrase McCoy) to command much attention. This book may be recommended as one of the most useful works written on the processes of dyeing. It is practical for the dyer and sufficiently theoretical for the man who wishes to contact the dyeing industry.

The book starts with a most concise and readable account of the history of dyeing and then discusses the application and methods of use of various types of dyestuffs—basic, acid, resorcine, alizarine, direct cotton, sulfur, azoic, vat, and dyestuffs produced on the fiber by oxidation of coal tar products. It then proceeds into the actual details of dyeing of synthetic fibers, on which Whittaker is an acknowledged authority, and the dyeing of union materials. The practical problems which arise are pointed out and solutions suggested. A special section deals with the evaluation and identification of dyestuffs.

The chapter on auxiliary products for textiles as surface active agents and water and crease proof finishes is the only part of the book with which fault can be found. It is too sketchy to be of much real service other than for cursory information.

"TOXICITY OF INDUSTRIAL ORGANIC SOLVENTS." Report No. 80 of the Medical Research Council of the Industrial Health Research Board of Great Britain. Compiled by *Ethel Browning*. Published by Chemical Publishing Co., New York. 382 pages. Price $3.50.

THE MAJOR CHEMICAL companies of this country are rapidly realizing the adverse effects upon workers of the large majority of solvents in use. Witness, for example, the excellent work of the Du Pont Haskell Laboratory of Industrial Toxicology in Wilmington, Delaware. Governments, more slowly, are recognizing the problem by passing safety codes. The Austrian government, for example, in 1934 forbade employing workers for more than four hour shifts in rubber plants using toluol. In some instances the shifts were shortened to two hours.

The present book is one of the best available on its subject and was prepared for the British government. It divides the solvents into eight types: hydrocarbons, halogenated compounds, alcohols, esters, cyclohexane derivatives, ketones, glycol derivatives, and miscellaneous as carbon bisulphide, pyridine and ether. For each solvent a brief résumé of uses is given, then the methods of estimating vapor content in the air, and finally, the pharmacological properties. The work is thoroughly documented. It should be on the shelves of every individual or firm using solvents where toxicity hazards may exist.

THE PRINCIPLES OF METALLOGRAPHIC LABORATORY PRACTICE. By *George L. Kehl*. Published by The McGraw Hill Pub. Co., New York, N. Y. 359 pages. Price $3.50.

Reviewed by *Edward S. Johnson*

THE EXPOSITION of the laboratory craft of which this manual treats opens with a description of the preparation of specimens for microscopic investigation, sampling, grinding, polishing, mounting. This is followed by a section on etching for microscopic examination which may be chemical, mechanical or electrolytic. Metallurgical microscopes and photomicrography are dealt with extensively. The chapters on microscopic examination of metals cover somewhat wider areas being limited to about 10 diameters and affording a lever for control in manufacture. In hardness testing machines of many models are shown and precision instructions for use are given. The various metallurgical tests seem to indicate that the future holds possibilities of help from X and gamma ray studies.

There is a voluminous appendix of tabulated digests of the entire text with precisely indicated procedures for the practitioner.

CASEIN

CASEIN AND ITS INDUSTRIAL APPLICATIONS. Second Edition. By *Edwin Sutermeister* and *Frederick L. Browne*. Published by Reinhold Publishing Corp., New York, N. Y. 433 pages. Price $6.50.

Reviewed by *T. R. Olive*

THIS BOOK, NO. 30 of the A. C. S. Monograph Series, is a thorough revision of an earlier volume edited and in part written by Messrs. Sutermeister and Browne, which appeared in 1927. As far as possible each of the chapters has been revised or completely rewritten by the original authors. During the interval since the first edition, casein technology, both in manufacture and in use, has improved materially. Old uses have been extended and several totally new uses, such as for paste paints, fiber and foil, have come into the picture.

The book is divided roughly into three sections, with three chapters on occurrence and chemistry, three on manufacture, testing and storage and six on use. Plastics, glues, uses in paper making, in paints, in the leather industry, in food and medicinals and in miscellaneous applications all have separate chapters. Considering the authority of the editors and their eight collaborators and the evident care that has gone into the revision, the book would appear to be the best of those now available on the subject.

CASEIN AND ITS USES. By *Hans Hadert*. Translation of Second German Edition with Additions by *Henry Goldwater*. Published by Chemical Publishing Co., New York, N. Y. 98 pages. Price $3.

HARDLY MORE THAN a collection of formulas for applications of casein, this little book will probably find some use among non-technical readers. Printed from photographically prepared plates made from typewritten originals, the book suffers considerably in appearance and format compared with other currently

available casein literature. The reproduction of original German half-tones is of little value to American readers. It is to be hoped that the translation is more accurate than the relettering of a drawing which was reproduced without permission from *Chem. & Met.*

METAL COATING

PROTECTIVE COATINGS FOR METALS. By *R. M. Burns* and *A. E. Schuh*. Published by Reinhold Publishing Corp., New York, N. Y. 385 pages. Price $6.50.

Reviewed by *James A. Lee*

THIS BOOK REPLACES "Protective Metal Coatings" by H. S. Rawdon in the American Chemical Society series of monographs. He was not in a position to undertake the task of revision and so the present authors were invited to accept the responsibility. These chemists are unusually well equipped to undertake the preparation of a volume on protective coatings for they have long made investigations and contributed to our knowledge of the protection offered by the many various types. Also, since interest has been that of the user of large volumes of various kinds of protective coatings they are in a position to give an unbiased opinion of the comparative protection offered by the many materials. They have prepared the text from the viewpoint of the engineer with problems of protection to be solved. It is not intended to be a manual for the production of coating compounds although considerable information is given on this phase of the subject in order that the reader may have a better understanding of the nature of the various materials.

PHOTOGRAPHIC CHEMISTRY

PHOTOGRAPHIC CHEMICALS AND SOLUTIONS. By *J. I. Crabtree* and *G. E. Matthews*. Published by American Photographic Publishing Co., Boston, Mass. 360 pages. Price $4.

THERE IS A GREAT DEARTH of literature in the field of photographic chemicals. This book, representing twenty-five years of study in the Research Laboratories of the Eastman Kodak Company on compounding photographic solutions and studying their application to photography should fill a much felt lack. Much hitherto unpublished information is given in addition to a compilation of material of practical value contained in scientific papers cognate to the subject. In one comparatively small volume the authors have not only compiled all this material, but have done it in such a way as always to keep in mind the requirements not only of the large consumers of photographic chemicals, but of amateurs, scientific investigators, X-ray technicians and the motion picture industry as well.

The purpose of the book is to bring to all these groups knowledge and understanding of the fundamental principles of solution preparation and use. The book contains chapters on photographic chemical formulas, arithmetic and conversion of formulas, apparatus, materials of construction for photographic processing apparatus, storage and transportation of chemicals, substitution of chemicals and technique of mixing and using.

The book is simply written and clearly printed enabling the most inexperienced readily to understand its contents, but on the other hand it is by no means too elementary for the professional photographer or maker of photographic chemicals because of its detailed completeness and explicitness.

WORLD ECONOMIC REVIEW OF INSECTICIDES AND ALLIED PRODUCTS. By O. W. Roskill & Co., Ltd., London, England. Price 5 £.

A COMPILATION OF DATA rather than an expression of personal knowledge, this detailed review covers sources of supply, competition among different products, relative prices and price trends, the economic impact of technical changes, data on production, trade and consumption, imports and exports and a host of other problems that have hitherto received little attention. Most of the statistical data is available in one form or another in the various government documents and private publications on the subject. However, this is the first time one publication has tried to cover the whole field giving both figures and trends. The reports tell not only total imports of any one country, but allocate each part of this total in the proper country. Various large producers of the different insecticides are mentioned by name and their total production given as well as a good many of their import and export figures. Much information is given on raw materials, their sources and consumption. This book should be of value on the commercial side and may provide the economic background against which technical research might be planned by the various manufacturers in this and allied fields.

TEXT BOOKS

THE CHEMISTRY OF ORGANIC COMPOUNDS. Revised Edition. By *James B. Conant*. Published by the Macmillan Co., New York, N. Y. 658 pages. Price $4.

TO QUOTE THE AUTHOR in his preface, "recent discoveries have undoubtedly a pedagogic value by virtue of the fact that they are recent," gives us a key to the book. Since 1933, when the first edition appeared, there have been many new developments having both industrial and biological implications. This text attempts to keep up with the new industrial advancements as well as with the new organic reactions now finding application in synthetic and structural research. To quote the author again the aim of this revision has been "to balance the importance of the material characteristic of the usual elementary textbook against the significance to the students of new developments." The basic principles of organic chemistry are extensively dealt with as they were in the first edition, but there is condensation and consolidation of chapters on individual chemicals to enable the author to give more extended space to practical industrial material.

INORGANIC CHEMISTRY FOR COLLEGES by *J. F. Norris* and *R. C. Young*. Published by McGraw-Hill Book Co., New York, N. Y. 750 pages. Price $3.75.

THIS TEXT BOOK for the first year university student is designed to reduce to a minimum the need for professional guidance in its use and is, as far as possible, complete within itself.

The theoretical bases of inorganic chemistry are explained with the clarity typical of the lectures of the senior author and are introduced gradually in the text at requisite places. The frequent references to the practical applications of the various inorganic elements and compounds are commendable. This type of textbook is of a new character although rapidly gaining in popularity.

RECENT BOOKS AND PAMPHLETS

Arc Welding in Design, Manufacture and Construction. Compiled and published by The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. Price $1.50. The first complete edition of this voluminous work is now on the market. It includes 109 original studies of welding by acknowledged leaders in various branches of industry. These studies are the outstanding papers of the recent $200,000 Award Program. The book provides for scientific and technical schools, colleges and universities, engineering bodies and libraries, as well as industrial executives and officials and others desirous of obtaining the benefits attributed to arc welded construction. Photographs and drawings essential to a clear and adequate presentation of each subject are included. Each study includes designs, calculations, procedures and other pertinent information showing how the advantages attributed to arc welded construction are obtained. The contents of the book are arranged as chapters of 10 sections including ones on automobiles, aircraft, railroads, watercraft, structures, containers, machinery and commercial welding.

Seventh International Management Congress Proceedings. Published by The Waverly Press, Inc., Baltimore, Md. Price $2. The purpose of this congress is to provide a forum for interchanging world experience in all phases of management, thereby attempting to aid the economical production and distribution of goods and services in industry and agriculture. More than one thousand representatives represented 24 countries and 200 papers delivered at the congress are herein given in toto. Among the topics covered are industrial relations, wage administration, safety and health, distribution and sales planning.

The Comparative Values of Chest Roentgenograms Made on Film and on Paper for Industrial Surveys. Compiled and published by Air Hygiene Foundation of America, Inc., Pittsburgh, Pa. This bulletin compares various available X-ray methods, but bears in mind the primary importance of diagnostic accuracy. There is a complete description of Roentgenograms including physical characteristics, experimental procedure, exposure techniques and

conclusions concerning results of actual experiments. A number of very detailed charts of specific cases are included.

The Mechanical Testing of Bituminous Road Materials, A Survey of The Literature. Special Report No. 1, Road Research and Experiment, Department of Scientific and Industrial Research and Ministry of Transport. 47 pages. Available from The British Library of Information, 50 Rockefeller Plaza, New York City, 30 cents. This report is a critical digest of the literature prepared in connection with the study of the physical and mechanical properties of bituminous road surfacing materials.

Nitrous Fumes. Leaflet No. 5, Methods for the Detection of Toxic Gases in Industry, Department of Scientific and Industrial Research. 9 pages. Available from The British Library of Information, 50 Rockefeller Plaza, New York City, 10 cents. This is one of a series of leaflets describing simple and rapid means of measuring low concentrations of toxic gases in industrial atmospheres.

Elektrochemie Geschmolzener Salze. By Dr.-Ing.-habil. Paul Drossbach. Published by Verlag von Julius Springer, Berlin. 144 pages. Price 12 R.M. Approximately two-thirds of the volume is devoted to thermodynamic theory. The remainder of the book includes very brief descriptions of the electrolytic preparation of metals in fused electrolytes. No engineering aspects of the subject are included.

L'Electrochimie et L'Electrometallurgie. Tome I—Electrolyse. Tome II—Fours Electriques. Fourth Edition. By Albert Levasseur. Published by Dunod, Paris. 210 and 254 pages. Price 72 francs and 78 francs. The first volume follows the conventional discussion of the Faraday laws, conductance, ionic migration, electromotive force, and polarization. The industrial section deals briefly with alkalies, chlorine, chlorates, and persalts. The second volume concerns itself with electrothermics, furnaces, and the products of the electric furnace.

Survey of Carbon Disulphide and Hydrogen Sulphide Hazards in the Viscose Rayon Industry. Bulletin No. 46, Occupational Disease Prevention Division, Pennsylvania Department of Labor and Industry, Harrisburg, Pa. 69 pages. This reports medical findings of a coordinated group-study of symptoms of poisoning with a method which was developed in this study. It indicates practical control measures adaptable for any industry with CS_2 or H_2S hazards.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.

The Storage of Sweet Cherries as Influenced by Carbon Dioxide and Volatile Fungicides, by Fisk Gerhardt and A. Lloyd Ryall. U. S. Department of Agriculture, Technical Bulletin No. 631; 5 cents.

Cause and Prevention of Blue Stain in Wood. Forest Products Laboratory, Technical Note No. 225. Available only from Forest Products Laboratory, Madison, Wis.; processed.

Utilization of Cotton and Other Materials in Fertilizer Bags, by R. J. Cheatham and Robert B. Evans. Bureau of Agricultural Economics; mimeographed.

Accidents in the Petroleum Industry of Oklahoma in 1937, Summarized and Compared with 1923, by C. F. McCarroll. Bureau of Mines, Report of Investigations 3446; mimeographed.

Some Data on Dust in Industrial Work, by D. Harrington. Bureau of Mines, Information Circular 7072; mimeographed.

Analyses of Pennsylvania Bituminous Coals, by George H. Ashley. Bureau of Mines, Technical Paper 590; 50 cents.

Spontaneous Combustion of Coal, by O. P. Hood. Bureau of Mines, Information Circular 7074; mimecgraphed.

Sulfur in the Products of Combustion of Fuels, by L. R. Burdick and J. F. Barkley. Bureau of Mines, Information Circular 7065; mimeographed.

Expansion of Coal During Coking, by H. S. Auvil, J. D. Davis, and J. T. McCartney. Bureau of Mines, Report of Investigations 3451; mimeographed.

Analyses of Crude Oils from Some Fields of Oklahoma, by O. C. Blade. Bureau of Mines, Report of Investigations 3442; mimeographed.

Typical Oil-Field Brine-Conditioning Systems: Preparing Brine for Subsurface Injection, by Sam S. Taylor, C. J. Wilhelm, and W. C. Holliman. Bureau of Mines, Report of Investigations 3434; mimeographed.

Effect of Acid Treatment Upon the Ultimate Recovery of Oil from Some Limestone Fields of Kansas, by R. E. Heithecker. Bureau of Mines, Report of Investigations 3445; mimeographed.

Printed pamphlets giving final statistics of production from the 1937 Census of Manufactures are now beginning to appear. A few of those issued thus far are: Electrical Machinery, Apparatus, and Supplies, Radios, Radio Tubes, and Phonographs; Buttons, Carbon Paper and Inked Ribbons, Synthetic-Resin and Other Plastic Products, Umbrellas and Canes; Glue and Gelatin, Grease and Tallow, etc. 5 cents each.

Consumption of Fuel and Purchased Electric Energy, Census of Manufactures 1937. Bureau of the Census; processed.

Various releases from the 1937 Census of Electric Light and Power Industry have been issued, giving statistics on: Generating Facilities, Generated Output, and Fuel Consumed, by Classification of Reporting Sources and by Geographic Divisions; Privately-Owned Electric Utilities; Municipally-Owned Electric Utilities; Sales of Electric Energy, etc. Bureau of the Census; processed.

Statistical Classification of Imports into the United States, with Rates of Duty, Effective January 1, 1939. Bureau of Foreign & Domestic Commerce, Schedule A; 45 cents.

Imports, Exports, Domestic Production and Prices of Petroleum, Coal, Lumber, and Copper. U. S. Tariff Commission; processed.

Foreign Trade of the United States, Calendar Year 1938, Part I.—Summary, by Grace A. Witherow. This printed pamphlet, Trade Promotion Series No. 198, is available only from Bureau of Foreign & Domestic Commerce. Part II of this series, available later this year, will give foreign trade statistics by countries.

Foreign Commerce Yearbook 1938. Bureau of Foreign and Domestic Commerce; $1.00 (Buckram).

Exporting through Webb-Law Association, with appendix containing Export Trade Act, Sherman Antitrust Act, Clayton Act, Robinson-Patman Act, Federal Trade Commission Act; and Wilson Tariff Act. Comparative Law Series, Vol. II, No. 6, June 1939. Bureau of Foreign & Domestic Commerce; 10 cents.

Basic Industrial Markets in the United States—Paint, Varnish, and Lacquer Industry, by O. C. Holleran. Bureau of Foreign & Domestic Commerce, Market Research Series No. 14.5; 10 cents. Available only from Bureau of Foreign & Domestic Commerce.

Marketing Research Activities of Manufacturers, by Elma S. Moulton. Bureau of Foreign & Domestic Commerce, Market Research Series No. 21. Available only from Bureau of Foreign & Domestic Commerce; 25 cents.

Developed and Potential Water Power of the World. U. S. Geological Survey; mimeographed.

Investigation of Concentration of Economic Power. Hearings before Temporary National Economic Committee, Part 2, covering patents in automobile and glass container industries; 75 cents.

Consumers' Cooperation in the United States, 1936, by Florence E. Parker. Bureau of Labor Statistics, Bulletin No. 659; 25 cents.

Statistics on Whiskey, Brandy, and Rum for 1938. Federal Alcohol Administration, press release No. 170; mimeographed.

A Study of Quartz-Fusing Operations with Special Reference to the Measurement and Control of Silica Fumes, by Edward C. Riley and J. M. Dallavalle. Public Health Service, Reprint No. 2042; 5 cents.

Milk Supplies and Their Control in American Urban Communities of Over 1,000 Population in 1936, by A. W. Fuchs and L. C. Frank. Public Health Service, Bulletin No. 245; 10 cents.

Protozoan Plankton as Indicators of Pollution in a Flowing Stream, by James B. Lackey. Public Health Service, Reprint No. 2004; 5 cents.

Water-Pollution. Hearings were held during March 1939 in both Houses of Congress on control of water-pollution; 20 cents (Senate hearings), 15 cents (House hearings).

Trade marks. Hearings by House Committee on Patents during March 1939; 25 cents.

T. V. A. Investigating Committee Report. Senate Document 56, 76th Cong., 1st Sess.; $4.60 (set of 3 volumes).

State Conservation of Resources, by Clifford J. Hynning. National Resources Committee; 15 cents.

Effect of Cleaning Seed Cotton on Lint Quality and Ginning Efficiency, by Francis L. Gerdes, Arvid J. Johnson, and Charles A. Bennett. U. S. Department of Agriculture, Technical Bulletin No. 663; 20 cents.

Relative Importance of Leading Industries, for the United States. Census of Manufactures 1937. Bureau of the Census; processed.

Wage Earners, by Months: 1937. Census of Manufactures. Bureau of the Census; processed.

Recent Trends in Employment and Productivity in the Oil and Gas Fields. Bureau of Mines, Mineral Market Series No. 728; mimeographed.

Securities & Exchange Commission has been issuing reports of interest to chemical process industries. Those relate to cement, chemicals and fertilizers; tires and other rubber products; containers and closures other than wood; sugar refiners; and oil refiners. Available only from Securities & Exchange Commission.

Your Plant NOTEBOOK

ANCHORING UNDERGROUND STORAGE TANKS BURIED IN WET GROUND

By JAMES O. G. GIBBONS
Mechanical and Electrical Engineer
Bloomfield, N. J.

IT IS OFTEN necessary to bury fuel-oil and other tanks in wet ground, in which case there is always the danger that when empty, the tanks will float, thus causing a lot of expensive trouble.

Obviously, the remedy is to weight the tanks down, or anchor them to a heavy foundation. Of course, there is no real difficulty in calculating the amount of anchorage required, but the writer has found the following to be a satisfactory method of dealing with the problem, and one which will insure absolutely reliable results. The only exception to this reliability is when the nature of the soil is such that it is actually soluble in water. When this condition is met, it is better to ignore the weight of the earth and use sufficient concrete to provide the total anchorage required.

Let us assume that we have a 20,000-gal., horizontal fuel-oil tank to be buried with its top 2 ft. underground. The high-water level is also 2 ft. below the ground level. Of course, if it is more or less, we must make allowances.

For this capacity we will use a tank, 10 ft. in diameter and about 34 ft. long. Underneath this we will place a 12x35-ft. concrete mat.

If we make the concrete mat 6 in. thick, we shall have an excavation 35x12x12½ ft. If this excavation should fill with water to within 2 ft. of the top, we shall have about 35x12x10½x62.4, or 274,500 lb. of water, which must be replaced by an equal weight of material.

The concrete mat weighs about 35x12x½x140, or 29,400 lb., and the empty tank about 16,000 lb.

The volume of the tank will be about 20,000x0.134, or 2,680 cu. ft. and the excavation after the concrete mat is in, 35x12x12 or 5,040 cu. ft. Hence there is 5,040—2,680 or 2,360 cu. ft. to be filled with earth, which at 100 lb. per cu. ft. would weigh 236,000 lb. This, together with 29,400 lb. for the mat, and 16,000 lb. for the empty tank, gives us 281,400 lb., which is slightly more than 274,500, and therefore safe.

It is often necessary to put a concrete pavement over the tank excavation, which will weigh about 40 lb. more per cubic foot than the earth which it displaces. This can be added to the loading and the thickness of the tank foundation mat reduced, possibly to 4 in. In some locations which are swampy, high water is at ground level, so the extra weight of the pavement will probably be needed, even with a 6-in. mat. It is well in this case to build concrete piers between the pavement and the top of the tank, so that the tank with its mat, will not float up through the wet fill.

Method Assures Correct Design

The great advantage of this method of figuring, is that at every stage we know exactly what we are doing, and any allowances which we may decide to make will be based upon considered judgment and not upon blind guesses, as is too often the case.

The proper anchoring of the tank to the concrete mat is important, as when empty, the tendency to float is 20,000x8 1/3 or nearly 167,000 lb., less 16,000 lb. for the weight of the tank, which gives 151,000 lb net.

The cheapest way of anchoring is to provide hooks in the concrete mat and lash the tank down with steel cable. This is satisfactory if it can be certain that the right class of cable will be used and that the field crew will make a perfectly good job of it. But these are matters about which one seldom can be quite certain.

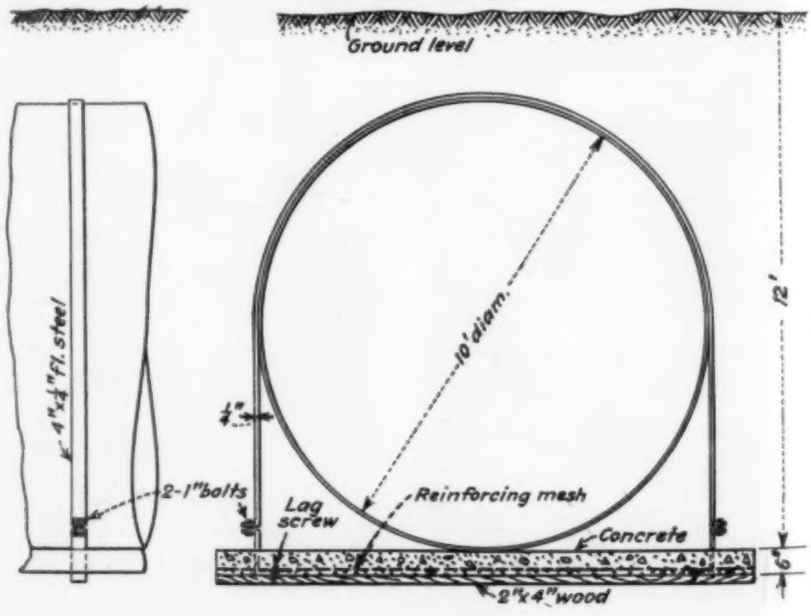
The individual lashings can be correctly figured and made up in the shop under proper supervision, with turnbuckles attached, but this will not cost much less than the steel straps shown in the illustration and will not make so reliable a job.

If six straps are used on the 20,000-gal. tank, they will have to take care of over 12½ tons each, so the importance of correct design is evident.

The illustration shows a typical strap anchorage. The size of the straps and bolts must, of course, be figured to meet the requirements of each individual case.

It will be evident that the 2x4-in. wood strips (or other convenient size) shown under the straps are to provide convenient forms for setting the straps and for holding them in place until the concrete has set. They do not serve any particular purpose after that.

Iron tank, 10 ft. in diameter and 34 ft. long, anchored to a 12x35-ft. reinforced concrete mat 6 in. thick



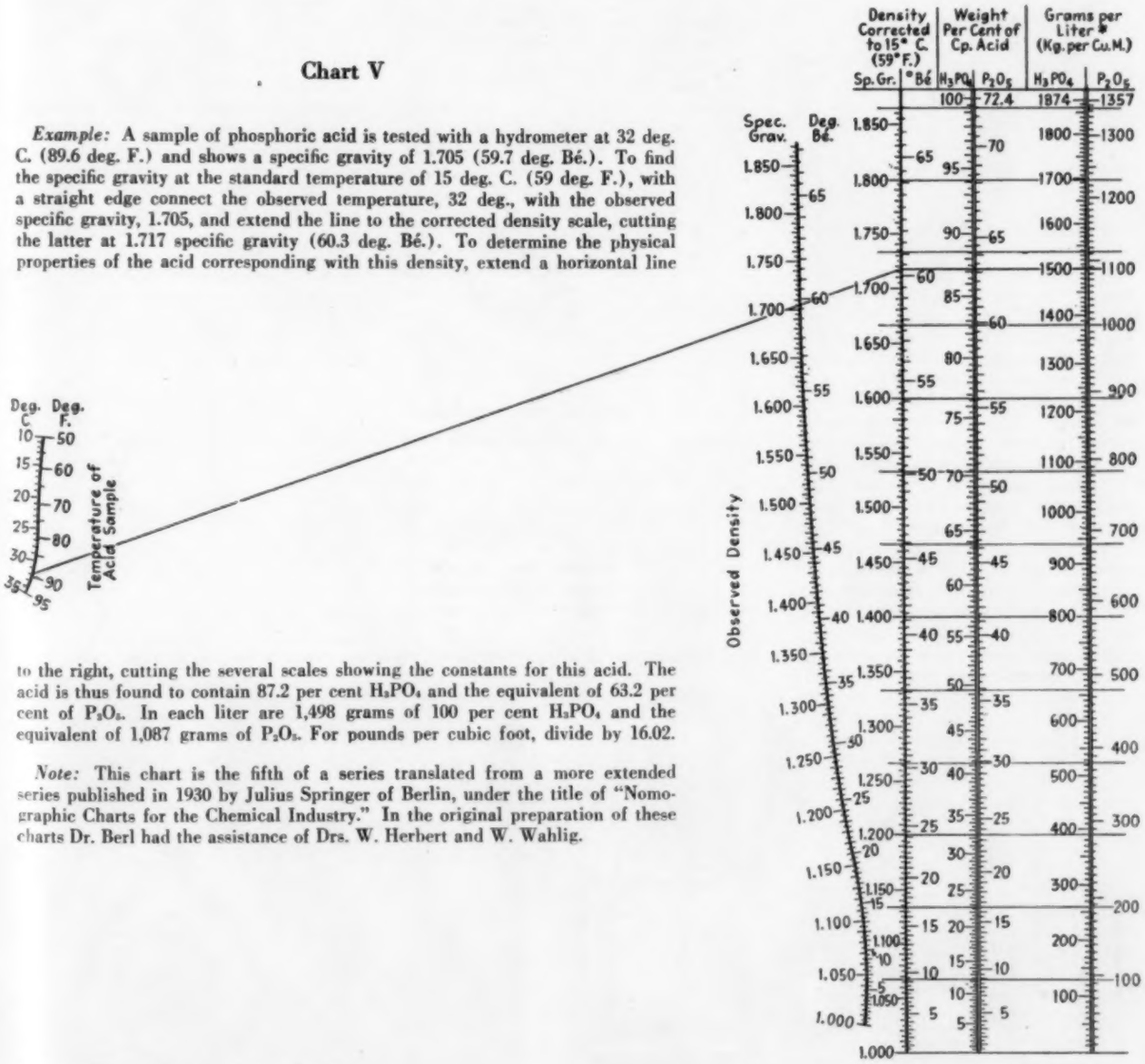
Nomographic Chart for Temperature Correction of Phosphoric Acid Densities, With Additional Scales for Interconversion of Physical Data

By ERNST BERL
Research Professor
Carnegie Institute of Technology
Pittsburgh, Pa.

Chart V

Example: A sample of phosphoric acid is tested with a hydrometer at 32 deg. C. (89.6 deg. F.) and shows a specific gravity of 1.705 (59.7 deg. Bé.). To find the specific gravity at the standard temperature of 15 deg. C. (59 deg. F.), with a straight edge connect the observed temperature, 32 deg., with the observed specific gravity, 1.705, and extend the line to the corrected density scale, cutting the latter at 1.717 specific gravity (60.3 deg. Bé.). To determine the physical properties of the acid corresponding with this density, extend a horizontal line to the right, cutting the several scales showing the constants for this acid. The acid is thus found to contain 87.2 per cent H_3PO_4 and the equivalent of 63.2 per cent of P_2O_5. In each liter are 1,498 grams of 100 per cent H_3PO_4 and the equivalent of 1,087 grams of P_2O_5. For pounds per cubic foot, divide by 16.02.

Note: This chart is the fifth of a series translated from a more extended series published in 1930 by Julius Springer of Berlin, under the title of "Nomographic Charts for the Chemical Industry." In the original preparation of these charts Dr. Berl had the assistance of Drs. W. Herbert and W. Wahlig.



* For pounds per cubic foot divide by 16.02.

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Process Equipment NEWS

Machinery, Materials and Products

Electric Variable Speed Drive

USING a method which has long been employed in the variable speed driving of large units, Reliance Electric & Engineering Co., Cleveland, Ohio, has developed a small "packaged" all-electric variable speed drive at present available in sizes to 15 hp. According to the manufacturers, one of the best methods of speed control has always been the use of a variable speed d.c. motor. On the other hand, now that alternating current is so universally used, the complexities of converting from alternating to direct current for the use of direct current motors has frequently prevented this course except in large applications.

The new drive system consists of a small, vertical motor-generator set which operates on alternating current and produces direct current which is supplied to a Reliance Type T direct current motor designed particularly for adjustable speed service. Only simple wiring is required and only simple contactors needed for control. Control elements consist of push buttons and a rheostat for speed changes. A practically infinite number of speeds within an overall speed range as great as 12 to 1 may be secured with this equipment. The accompanying illustration shows the application of one of the new Reliance variable speed drives to a Cameron paper winder. In the left foreground is the vertical speed control unit (motor-generator set), and in the right foreground, the variable speed direct current driving motor.

Man-Cooling Fan

SOUTH BEND AIR PRODUCTS, INC., South Bend, Ind., has recently placed on the market a new heavy-duty Aerospot fan particularly adapted to man-cooling service in large plants. As appears from the accompanying illustration, the unit is of sturdy construction with a frame of heavy welded steel tubing and a rolled angle-ring base. A fully inclosed ball-bearing motor, magnetic starter and push-button control are standard equipment. The fan employs forged aluminum alloy blades, designed to provide uniform air velocity across the entire blade area. Various sizes are available for capacities from 3,000 to 26,500 c.f.m.

Electric Temperature Regulator

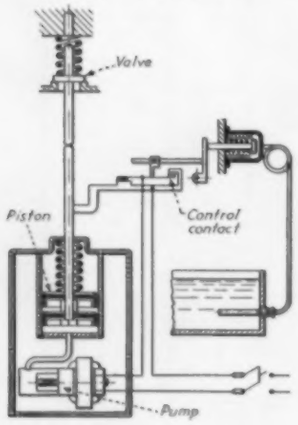
COMBINATION of the simplicity and compactness of the self-operated regulator with the sensitivity and accuracy of electric control is the claim for the new Type SE self-contained electric temperature regulator recently announced by the Sarco Co., 183 Madison Ave., New York, N. Y. As is indicated in the accompanying diagrammatic sketch, the temperature controller is actuated by a fluid-pressure sensitive system which controls the electrical circuit to a small motor-driven pump. The pressure produced by this pump is used to open the valve which is normally closed.

When the electric current is switched on, the motor and pump start, forcing oil into the cylinder and forcing the piston upward. The position at which the follow-up system opens the circuit and stops the motor is determined by the instantaneous relation of the controlled temperature to the desired set point. The effect of the system of linkages and switches shown is to cause the valve to float, through alternate starting and stopping of the motor, at the position which gives the flow of heating fluid necessary to maintain the desired temperature. The new regulator is available in valve sizes ranging from ½ to 4 in.

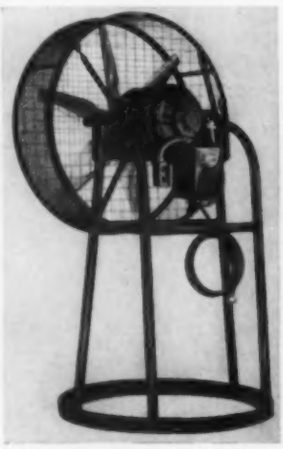
Power Scoop Truck

FOR DIGGING, transporting and dumping loose materials such as crushed coal, sulphur, salt, fertilizer ingredients and complete fertilizers, the Elwell-Parker Electric Co., Cleveland, Ohio, has developed an electric powered truck equipped with a rotating and lifting scoop as shown in the accompanying illustration. This equipment is designed to dig the material, carry it to the point of use or storage, and dump it on to a

Diagrammatic sketch of self-contained temperature regulator



New man-cooling Aerospot



Reliance variable speed drive on a paper winder

Electric-powered scoop truck

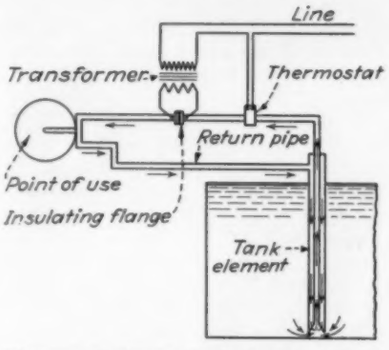


Diagram of viscous liquid heating system

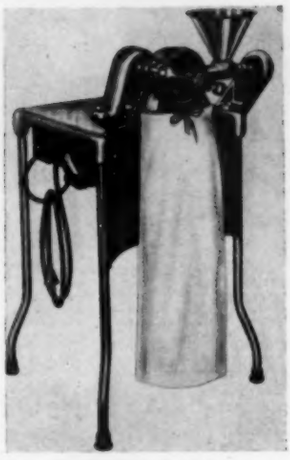
pile, into a hopper or lift it sufficiently to drop over the edge of a processing tank.

Another new development announced by this concern is a compactly built truck of the center control fork type, Model F-16, rated at 6,000 lb. This truck is built in both telescoping and non-telescoping types and is fitted with a two-prong fork for carrying pallets, on which the load is packed for storage and handling. The fork hoist is supplied with a slip clutch for protection against excessive overloads. An electromechanical brake holds the load at the will of the operator. In lowering the load, regenerative braking is employed to return electric current to the battery.

Pipe Line Heater

A NEW electric heating system for pipe lines carrying viscous liquids such as heavy fuel oil or other bituminous products has been announced by Albert G. Purdue Associates, 303 Wooster St., New Haven, Conn. This method, known as the Lines Thermal Electric Conduction System, comprises a special low-voltage transformer, a specially designed electrically insulated tank head with outlets for suction and return, and a thermostat of the fluid-filled, self-actuated type for controlling the primary of the transformer and maintaining the circulating liquid in the pipe line at a predetermined, adjustable temperature.

One of several possible hook-ups of this equipment is shown in an accompanying drawing. The system, which is recommended only where recirculation of the viscous liquid is employed, makes use of standard steel pipe which is made part of the circuit of the secondary of the transformer. Thus a low-voltage, high-amperage current flows through the pipe, as well as through the part of the heating system contained within the tank, and the heat produced in overcoming the resistance of the system maintains the necessary fluidity of the liquid.



New small-capacity pulverizer

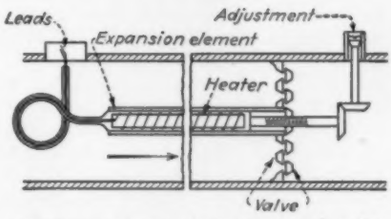


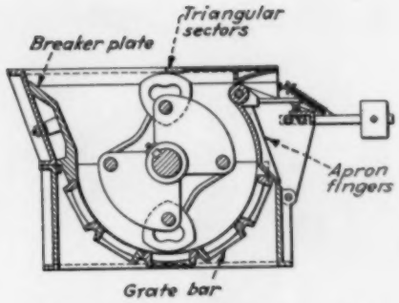
Diagram of new electric control valve

Small Pulverizer

LABELED the Bantam, a small, inexpensive, portable pulverizer similar in principle to its larger Mikro-Pulverizers has been put on the market by the Pulverizing Machinery Co., Roselle Park, N. J. Like its larger counterparts, the Bantam is said to be dustless, accessible and easy to clean. It can be taken apart for cleaning in two minutes by the average unskilled workman. The mill is of the swing hammer type with a single motor-driven feed screw driven by a separate rheostat-controlled motor. Typical capacities are 50-200 lb. per hour on dry colors and pigments; 30-100 lb. on dyes; and 30-150 lb. on pharmaceutical chemicals.

Ring-Type Crusher

ELEVEN SIZES with rotors ranging from 13½x13 in. to 34x49 in. are available in the new line of S-A ring-type crushers recently announced by Stephens-Adamson Mfg. Co., Aurora, Ill. The new crushers feature crushing elements consisting of triangular-shaped manganese steel sectors arranged in two gangs on opposite sides of the rotor, which are said to permit the access of exceptionally large lumps to the splitting action of the impact corners of the sectors. This cracking action is claimed to minimize the production of undesired fines. Among the materials handled with the new crusher are coal, peat, glass, limestone, salt, coke and similar materials. It is claimed that larger lumps can be handled with a given size machine than was formerly possible, and that the centrifugal action of the sectors automatically presents the least worn surface of the triangular crushing elements so as to equalize their wear.



Cross-section of ring-type crusher

Control Equipment

SEVERAL new devices for control and accessory purposes have recently been announced by Wheelco Instrument Co., 1929 South Halsted St., Chicago, Ill. One of these is a new self-contained electric control valve for the throttling of gas, oil or air flow to furnaces, ovens and similar heating applications. Combining valve and operator in a simple totally inclosed unit, the valve employs an electro-thermal expansion principle without mechanical movement other than the expansion and contraction of an inclosed operating cylinder. The inherent characteristics of the valve are said to minimize hunting, giving a quick first response, then a gradual slowing down of movement, thus avoiding overcorrection.

The valve consists of a short length of pipe containing an electrically heated expansible element which opens the valve by the differential thermal expansion of two metal cylinders. The result of current flow through the heater is to increase the length of one cylinder more than the other and so to move the movable valve disk element away from the fixed element and increase the opening. These features are shown in an accompanying drawing.

Another new development is a recording thermometer which this company has recently added to its line of control equipment. Various ranges from 0 to

New flow type pH electrode

1,900 deg. F. are available. Vapor pressure, liquid expansion, gas pressure and mercury filled thermal systems are available. At the same time the company has introduced a series of dial-indicating thermometers in both stem and distant-reading types, for similar temperature ranges.

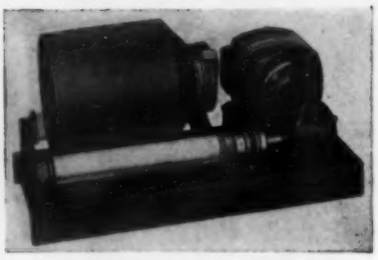
Still another development is the Series 3200 potentiometer controller. This makes use of the company's Capacitrol control system, which is an all-electric design, eliminating contacts, depressor bar mechanisms, cams and other mechanical moving parts. The instrument is of the null type with automatic cold-junction compensation. The same meter movement is used for standardization and controlling, the standard cell having been eliminated in this design.

Roller Type Jar Mill

FOR THE GRINDING and pulverizing of pigments, minerals, inks, colors, chemicals and similar materials, the United States Stoneware Co., Akron, Ohio, has introduced a new roller-type jar mill in which, to secure rotation of the jar, it is only necessary to place it on the revolving rollers. The simple design is indicated in the accompanying illustration. The revolving rollers are of rubber-covered steel, mounted in brass-bushed bearings. Standard sizes are arranged to accommodate from one to four of this company's Loxeal chemical stoneware jars, either of the 1, 1½ or 2 gal. size. The motor is of the geared head type. A supply of Danish flint pebbles for each jar standard equipment.

pH Electrodes

NATIONAL TECHNICAL LABORATORIES, 3330 East Colorado Blvd., Pasadena, Cal., manufacturer of the Beckman pH meter, has recently introduced two new electrode assemblies, one a flow type for incorporation in the piping of the system undergoing measurement and the other an immersion type for complete immersion in tanks and other equipment. Both



New roller type jar mill

are designed especially for industrial application. The flow type consists of a porcelain enameled flow chamber with 1 in. inlet and ¾ in. outlet threaded for standard pipe. The electrodes and temperature compensating thermometer are held in a stainless steel cover plate. A gasket permits moderate flow pressures to be maintained without leakage. The immersion type electrode also has the electrodes mounted in a stainless steel plate, but protected against damage by a framework of stainless steel rods. A stainless steel hood keeps the electrode connections dry and a ¾ in. connection accommodates a length of standard pipe for immersion to whatever depth is desired. Leads up to 500 ft. in length can be provided for remote connection to the meter.

Equipment Briefs

A NEW ENTRY into the acid-proof refractory field is Sauereisen-Fuchs & Co., Fulton Bldg., Pittsburgh, Pa. This company was recently organized to manufacture and market industrial ceramic and cement products. Among these is a new patented brick which is set with molten jointing compounds and is designed to give a jointless space in lining construction. According to the manufacturer, the life of an acid-proof lining is dependent largely upon the life of the joint. Hence, the absence of exposed joints is claimed to contribute largely to the elimination of tank failures. Structural strength of the linings is further improved by special interlocking and reinforcing features. The construction permits brick to be laid four high before the compound is poured. Labor savings are thereby claimed as well as a slight saving in the amount of jointing compound required.

ADDING to its line of industrial locomotives, the Brookville Locomotive Co., Brookville, Pa., has adapted the new 85 and 95 hp. Ford engines to this purpose. This company has been building Ford-powered industrial locomotives for more than 20 years. The present line includes models ranging from 2½ to 8 tons in size, in any gage. Locomotives are equipped with all-speed reverse, making all forward speeds available in either direction. Power plants can be serviced by any authorized Ford service station.

FOUR HOIST SIZES, in capacities of 250 to 1,000 lb., are available in a new line of Comet hoists recently announced by Chisholm-Moore Hoist Corp., Tonawanda, N. Y. These hoists, which are easily carried and installed by one man, are powered by specially built heavy-duty motors run on an ordinary light circuit, or on a three-phase power line, as desired. The design is claimed to be compact and rugged, but light in weight. Precision ball bearings are provided at each rotating point. A one-hand control permits a high degree of accuracy in lifting. A smooth, quick-acting brake is provided to prevent drifting of the load.

A STEAM TRAP of the inverted bucket type for pressures up to 900 lb. per sq.in. has recently been announced by the Sarco Co., 183 Madison Ave., New York City. Body and cover are steel forgings secured together by special alloy steel bolts. All interior parts, including the bucket, are of stainless steel, with a special hard stainless alloy used for the renewable valve seat and disk.

MANUFACTURERS' LATEST PUBLICATIONS

Apparatus. General Electric X-Ray Corp., 2012 Jackson Blvd., Chicago, Ill. —Publication 7A-560-1—20-page book on this company's X-ray diffraction unit, a new, smaller and more versatile type for analysis and testing.

Bearings. Johnson Bronze Co., 310 South Mill St., New Castle, Pa.—Catalog L-1—8-page price and stock list on this company's Ledaloyl bearings and bushings.

Belting. Mechanical Goods Division, U. S. Rubber Co., 1790 Broadway, New York, N. Y.—Form M9332—34-page "Belting Biographies," giving numerous case histories, alternating with technical data sections, on the applications of rubber transmission and conveyor belts.

Carbon Shell Chemical Co., San Francisco, Calif.—40-page handbook on this company's Shell Carbon, bound in stiff covers, summarizing pertinent facts regarding behavior and use of this material in rubber compounds with information on properties of such compounds, use of carbon, examples of compounding formulas, and glossary.

Chemicals. Tennessee Corp., Atlanta, Ga.—16-page booklet briefly describing agricultural applications of zinc sulphate.

Construction Materials. International Nickel Co., 67 Wall St., New York, N. Y.—Bulletin T-3—16 pages of technical information on the use of Monel metal in sulphuric acid, with information on resistance to corrosion and typical applications.

Corrosion. Crane Co., 836 South Michigan Ave., Chicago, Ill.—Technical Paper 408—104-page book on "Combatting Corrosion in Industrial Process Piping," by L. G. Vande Bogart, available at a price of $3. This book is an excellent job, covering numerous corrosion problems in considerable detail.

It consists of three parts, theory, piping materials and corrosive fluids. A section of ten pages gives condensed recommendations.

Corrosion. The LaBour Co., Elkhart, Ind.—12-page book by H. E. LaBour on the mechanics of corrosion, particularly as it affects pumps.

Electrical Equipment. Rowan Controller Co., Baltimore, Md.—Leaflet describing an improved oil-immersed control switch for corrosive atmosphere, using a separate wiring chamber which prevents oil or oil vapors from contacting lead wires. Also Bulletin 3931, 2 pages describing other features of the Type 780-KBF combination line starters using the new wiring chamber.

Electrical Equipment. Troy Engine & Machine Co., Troy, Pa.—Bulletin 108—24 pages on this company's steam-engine-powered generating sets for direct and alternating current in both vertical and horizontal types. Lists engineering data.

Equipment. Bradley Washfountain Co., North 22d and West Michigan Sts., Milwaukee, Wis.—4-page leaflet describing new group washing facilities made by this company.

Equipment. Chicago Pneumatic Tool Co., 6 East 44th St., New York, N. Y.—S.P.1996—4-page leaflet describing this company's horizontal duplex dry vacuum pumps; also supplement B to Bulletin 726, 8 pages describing in detail this company's horizontal tandem duplex motor-driven compressors.

Equipment. Colonial Alloys Co., Colonial Philadelphia Bldg., Philadelphia, Pa.—Bulletin 2639—Leaflet illustrating new line of Colalloy industrial vessels such as buckets, trays, tanks, etc.

Equipment. Logan Engineering Co., Lawrence & Lamon Aves., Chicago, Ill.—Bulletin 638—12 pages describing this company's Aridifier, a mechanical device for removing water, oil and other foreign matter from compressed air and other gases.

Equipment. Patterson Foundry & Machine Co., East Liverpool, Ohio—Catalog 395—96-page book describing a wide range of mixing and agitating equipment made by this company, including several new types. Also shows screens, cylindrical mills, rotary dryers and thickeners.

Equipment. The Pressed Steel Co., Wilkes-Barre, Pa.—Folder describing types of bubble cap made by this company and their advantages. Also folder covering this company's thermocouple protection tubes, listing sizes and prices.

Equipment. Worthington Pump & Machinery Co., Harrison, N. J.—Publications as follows: Bulletin S-500-B37, 6 pages on this company's evaporative coolers for engine jacket water. W-111-B6C, 6 pages on piston pumps for volatile liquids; W-341-B6, 4 pages on high pressure, high temperature centrifugal pumps.

Evaporators. Struthers-Wells, Titusville, Pa.—76-page catalog and handbook on evaporators. Catalog material subordinated to handbook material, the latter covering theory, performance data, information on evaporator variables, multiple-effect hook-ups, corrosion, practice in specific industries. Numerous useful charts, nomographs and tables are included.

Deodorization. Blaw-Knox Division of Blaw-Knox Co., Pittsburgh, Pa.—Bulletin 1678—4 pages briefly describing this company's continuous system of deodorization of vegetable oils.

Filter Aids. The Dicalite Co., 120 Wall St., New York, N. Y.—16-page booklet on filtration with filter aids, covering such subjects as advantages, rates with different filter aids, how they are used, costs and typical applications.

Filters. The Elmco Corp., Salt Lake City, Utah—Bulletin 402—26 pages on this company's rotary vacuum filters with information on manufacture, design, types, special features, dimensions and applications.

Grinding. Hardinge Co., York, Pa.—Bulletin AH344—Leaflet briefly describing a complete automatic control grinding installation for limestone, silica, clays and the like, including automatic feeder, "electric-ear" feed control and Thermo-Mill drying system.

Hydrometers. William Hiergesell & Sons, 295 Pearl St., New York City—Bulletin 205—12 pages giving description and prices on this company's Streamline Silvertip hydrometers in various types and numerous ranges; also covers lower-priced shot-weighted hydrometers.

Instruments. Ashcroft American Gauge Div., Manning-Maxwell & Moore, Inc., Bridgeport, Conn.—Newly revised book on this company's gages, covering varieties and types for all industries and services.

Instruments. The Bristol Co., Waterbury, Conn.—Publications as follows: 512, describes this company's system of coordinated process control; 525, bulletin on humidity recorders and controllers; 528, strip-chart pyrometers; 529, strip-chart resistance thermometers; 533, describes new Thermoverter used with potentiometers and millivoltmeters for a.c. electrical power measurement and totalization; 536, new line of pH recorders and controllers; 538, new portable voltmeter.

Instruments. Charles Engelhard, Inc., 233 New Jersey R. R. Ave., Newark, N. J.—Bulletin 800—24 pages describing in detail this company's methods of gas analysis with various modifications of the thermal conductivity cell. Emphasis is put on a new unit employing an all-quartz cell said to be particularly useful where corrosive gases are present.

Instruments. The Foxboro Co., Foxboro, Mass.—Bulletin 773—4 pages describing this company's pyrometers and resistance thermometers.

Instruments. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.—Folder N33B (2)—6-page folder describing this company's Rayotube pyrometer for the measurement of high temperatures; also Catalog E-33C (1), 16-pages on Mueller bridges for precision measurement of temperature.

Lubrication. Sun Oil Co., Philadelphia, Pa.—34-page book on industrial lubrication covering, largely in pictures, the production and refining of lubricating oil, applications and recommendations in specific industries.

Metals. Joseph T. Ryerson & Son, Inc., 16th & Rockwell Sts., Chicago, Ill.—240-page stock list and steel data book, giving detailed listing of many new products and sizes recently added to this company's stock. Many tables and other features of interest to steel and other metal users.

Mixing. Mixing Equipment Co., Rochester, N. Y.—Catalog B-66—8 pages on side-entering agitators with information on types, installation, uses, dimensions and other pertinent data.

Pipe. Republic Steel Corp., Advertising Division, Cleveland, Ohio—Adv. 333—44-page catalog on Toncan iron pipe with information on physical properties, corrosion resistance, economies of use, typical applications, case histories and other data.

Plastics. Plaskon Co., Toledo, Ohio—88-page Plaskon Handbook containing a large amount of information on mechanical and electrical properties of this material, its storage, handling, preforming and molding. Many useful tables are included.

Plywood Bonds. The Resinous Products & Chemical Co., 222 West Washington Square, Philadelphia, Pa.—28-page booklet bound in Tego-bonded plywood covers, discussing in considerable detail practical aspects of bonding materials, hot-press technique, plywood production with this company's Tego resin film material and with Uformite liquid resin bond.

Power Transmission. Columbia Vari-Speed Co., Liberty Bldg., Wheaton, Ill.—8-page folder giving detailed descriptive and engineering information on this company's JFS-Jr. V-belt-pulley type infinitely variable speed transmission.

Power Transmission. Morse Chain Co., Ithaca, N. Y.—Bulletin 57—32 pages on this company's flexible couplings, describing construction and applications, with engineering data.

Power Transmission. The Speedmaster Co., 1301 Washington Ave. S., Minneapolis, Minn.—6 pages describing this company's new V-belt-pulley type infinitely variable speed transmission.

Pulverizers. The Jeffrey Mfg. Co., Columbus, Ohio—Catalog 710—32 pages on this company's swing-hammer pulverizers showing types, performance data and dimension information.

Pump Priming. DeLaval Steam Turbine Co., Trenton, N. J.—Leaflet SP-1—Describes this company's electric-controlled, ejector-operated automatic priming system for centrifugal pumps.

Rare Gases. Air Reduction Sales Co., 60 East 42d St., New York, N. Y.—ADC-620—4-page leaflet answering questions about rare gases and their uses in gaseous tube lighting.

Refrigeration. Refrigerating Machinery Assn., Southern Bldg., Washington, D. C.—16-page "Equipment Standards," Parts I and II, Supplement A, formulated by this association and sold for 25 cents. Covers base specifications for self-contained ammonia units, ammonia brine cooler ratings, Freon-12 mains, and standard nomenclature for reciprocating compressors.

Safety. Davis Emergency Equipment Co., 55 Van Dam St., New York, N. Y.—Bulletin describing this company's face-shields in various types, for various degrees of hazards.

Separators. Stearns Magnetic Mfg. Co., Milwaukee, Wis.—Bulletin 93-A—Describes this company's line of automatic spout drum magnetic separators, giving complete specifications on various sizes.

Tubes. Babcock & Wilcox Tube Co., Beaver Falls, Pa.—Technical Bulletin 11-B—Gives specifications on this company's seamless tubular products made in carbon and alloy steels.

Tubing. American Metal Hose Branch, The American Brass Co., Waterbury, Conn.—Bulletin SS-25—24-page catalog covering in detail this company's seamless metal flexible tubing with information on its use for steam, liquids, gases and for controlling vibration and connecting misaligned and moving parts.

Turbines. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Bulletin B-2198—48 pages of detailed information on industrial applications of turbines, with particular reference to the generation of power as a byproduct of process steam production. Illustrates construction of various types of turbine and shows typical hook-ups and installations.

Valve Operators. Philadelphia Gear Works, G St. below Erie Ave., Philadelphia, Pa.—Two 4-page folders covering specifications and dimensions on this company's standard Type M-5 and its Type JS Limitorque valve operators.

Water Treatment. Elgin Softener Corp., Elgin, Ill.—Bulletin 602—16 pages on this company's Zeolite water softeners and other water conditioning equipment, discussing also iron and manganese removal, aeration and boiler water conditioning.

Chemical Engineering NEWS

Some Sections of Food and Drug Law Now Effective

Attention of the food and other industries affected by the new Food, Drug & Cosmetic Law has been called by the Food & Drug Administration chief, to the fact that despite final enactment of the Lea time extension amendment, a number of important sections of the new law became effective with the opening of business Monday, June 26.

Dr. Campbell however, stressed the fact that his administration has no unusual plans for making the effective date of the law. Indications were that the Administration will continue along the even tenor of its way, despite the fact that the new law extends materially the scope of the adulteration and other regulatory provisions of the old law.

Every change under the new law has been anticipated for a year, it was declared, and F&DA officials insisted that the administration will not change its policy of giving industry advice, comment and suggestions on all provisions of the new statute, which policy has been followed for the past year.

Dr. Campbell said "there will be no sudden, violent jerk, and no immediate revolutionary action. Events have been gradually working up to this throughout the year, and what is true for us also is true of industry as a whole."

Consent Decree Probable for Potash Industry

Officials of the Commerce Department, who have held a series of conferences with representatives of domestic potash producers and importers, are convinced that the potash industry may agree to a consent decree outlining trade practices and price policies, should the industry be indicted in connection with the investigation of the fertilizer industry.

Members of the potash industry have been asked to submit figures on the industry's structure, and suggestions for its future policy. Under the plan at present proposed, the Commerce Department would use this material in drafting a consent decree, which would then be submitted to the Department of Justice and the Federal court in which any action might be brought.

It is understood that both the Commerce and Justice Departments are anxious to cooperate in drafting such a consent decree for the potash industry, should it be accused of antitrust violations, in order to obtain a model for other major industries. It also is argued that such a method of procedure would show that the antitrust laws can be used to gain economic benefits for the public by methods other than criminal prosecution.

New Mineral Discovered by Interior Department

Discovery of a new mineral, officially named "shortite", was announced July 2 by the Department of the Interior. Composed of a double carbonate of sodium and calcium, the new mineral was found and identified by J. J. Fahey, chemist, in the Geological Survey laboratory. It was discovered as disseminated well-formed crystals in sections of core from the John Hay oil and gas well, drilled by Mountain Fuel Supply Co. on leased government land in Sweetwater County, Wyoming, at depths of 1,250 to 1,800 ft. below the earth's surface. Shortite was named in honor of Dr. M. N. Short, a former geologist of the Survey who now is professor of optical mineralogy at the University of Arizona. The new mineral might be adapted to use in glassmaking and ceramics work should it ever be found in sufficient quantities.

Allied Chemical Not a Holding Company

The Securities and Exchange Commission has issued an order declaring the Allied Chemical & Dye Corp. not to be a holding company. Allied Chemical had requested the finding in view of its ownership of more than 10 per cent of the outstanding voting securities of American Light & Traction Co. which, under the Utility Holding Company Act, automatically makes the company a holding company unless the commission finds otherwise. In its findings, the Commission said that most of the business transactions between the applicant and the American Light antedate the acquisition of the stock.

F.T.C. Issues Regulations for Putty Industry

The Federal Trade Commission has formulated and issued trade practice rules for the putty industry. The rules are intended to prohibit false advertising and branding which is not truly descriptive of the product offered for sale. Representing any industry product as "chalk putty," "chalk whiting putty," or "true chalk whiting putty," as descriptive of putty the pigment of which is not composed wholly of pure chalk whiting is declared an unfair practice.

It is also declared an unfair trade practice, directly or by implication to represent any putty as containing white lead when such is not the fact; or as containing more white lead than is in fact present in the product; or as being white lead putty when the same in fact contains no white lead or when the putty does not contain white lead in sufficient proportion to impart to the product substantial and effectual white lead characteristics of properties.

Corn Products Refining Makes New Plastic

The Corn Products Refining Co. has started commercial production of zein, an aqueous alcohol soluble protein (prolamine) at its plant in Pekin, Ill. It is marketed under the name "Mazein" by the Corn Products Sales Co. and as "Mazite" by The Prolamine Products Co., Inc. Zein alone forms a brittle film and for most purposes requires a plasticizing material or a modifying agent. It is used for coating paper and allied materials, also in solid color printing of paper and boxboard using aniline dyes. It may be used alone or with other resins for impregnating and laminating purposes as well as other molding operations. Zein plastics may be molded.

Farm Bureaus Sponsor Fertilizer Plant

Reports from Ohio state that a new dry mixing plant for production of fertilizers would be built at Cincinnati. The project is sponsored by the Ohio Farm Bureau Federation and the Indiana Farm Bureau Federation. The plant will cost approximately $200,000 and will have an annual capacity of 15,000 tons of fertilizer. The Ohio Farm Bureau Federation has been operating an experimental plant at Alliance for some months.

New Carbon Black Plant Planned for Montana

Articles of incorporation have been filed at Helena, Montana, by the Huber-Montana Co., which has been formed by officers of the J. M. Huber Co. and by carbon black operators in the Montana field. It is reported that the new corporation will erect a plant at Cut Bank, Mont. According to the plans the plant will consist of a chemical laboratory, a burning unit for carbon black production, and an absorption unit to remove butane and natural gasoline.

NEWS FROM WASHINGTON

Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

INTERNATIONAL questions were, during June, injected into many of the problems of Washington that are normally considered only domestic in nature. The monetary policy, the price for silver, the form of certain tax levies, and of course the neutrality bill, involved international policy questions of far-reaching import. But the motive back of much of this activity was purely bloc or personal politics of the members of the two Houses of Congress. Seldom have foreign affairs been so brashly used for domestic political purposes.

Much of the confusion during the last week of June came about because of the time limit on certain important items of legislation that were before Congress. The President's authority in monetary matters, special silver-purchase law, tax revision, appropriations for relief, and even some of the regular appropriation bills like those for the Department of Agriculture and for the District of Columbia, remained incomplete up to a few hours before the end of the fiscal year, June 30. This permitted logrolling, filibuster, and the playing of politics which would normally be impossible.

Some of the legislative results will probably have to be modified soon. Some may be even between July 1 and the date that the readers of *Chem. and Met.* read these pages. But it will take months, perhaps years, to reestablish some of the international relations left unbelievably disturbed by the actions of the Senate and by the failure of Congress to complete legislation on monetary matters until well after the lapse of the President's power. Some fear that serious retaliatory measures may be encountered in Mexico or the Orient, as Mr. Hull's arrangements with several nations were largely based on the old silver policy.

Material Stock Piles

For twenty years some of the mineral economists who are career men in the departments have striven to establish a basis on which the United States would build up in peace time reserves of strategic minerals to be used only in emergency periods. During June of this year they finally succeeded in having such a plan established by law. It provides not only for minerals, but on a wider basis for all strategic materials.

The new law provides that $100,000,000 will be invested in stocks of goods which will be put in reserve, not to be drawn on except in time of military emergency or threatened war. The selection of the commodities to be purchased and determining of technical specifications remains with a board headed by the Secretaries of War, Navy, and Interior who will be advised by their own subordinates and by technical representatives of State, Commerce, and Treasury. It is hoped that $25,000,000 of the total fund will be made available in the next appropriation bill, perhaps during July.

Although the greatest commotion has been made about such things as manganese, actually the purchases are more likely to emphasize United States need for commodities like tin and quicksilver. The commercial stocks held by industrial establishments of these latter metals are believed to be much farther from adequate than those of manganese ore, chromium, antimony, and tungsten. Although aluminum and nickel are on the strategic materials list they are not likely to be purchased because of the friendly relationship of Canadian production and capacity. Commodities of most direct interest to chemical enterprises are rubber, optical glass, quartz crystal, and coconut shell for char. The other items on this list are manila fiber, quinine, silk, wool, and mica.

By the fortunate coincidence the barter plan negotiated with Great Britain by Ambassador Kennedy makes quite a reserve stock of rubber available without purchase. That is particularly important because the emergency needs of that commodity are probably greater, measured in dollars, than of any other single item. In fact a rubber stock pile alone, calculated on the same basis as a mineral stock pile, that is for two years' supply during a war, would probably cost more than all of the mineral commodities together.

The purchasing is not necessarily limited to the above commodities on the "strategic" list. Other commodities on the "critical" materials list, 20 in number, may be purchased also. This list was established in January of this year to include the following: Asbestos, cadmium, coffee, cork, cryolite, flaxseed, fluorspar, graphite, hides, iodine, kapok, nux vomica, opium, phenol and picric acid, platinum, scientific glass, tanning materials, titanium, toluol, and vanadium.

News "Fines"

Food Label Delay—Many of the details of labeling foods, drugs, and cosmetics, as fixed by the Food and Drug Act of 1938, need not be observed until January 1, 1940. The effective date was June 25, 1939, until extension granted at the last minute by Congress. This extension does not extend to the general provisions of the law, but applies merely to named paragraphs, most of which deal with labels. A few items regarding the use of certified coal tar colors are postponed but the general provisions on this subject are not affected by the time extension amendment.

Filing Labor Contracts—Employers wishing to claim exemption from 44-hour week limits on the basis of special labor contracts must file these with the Wage-Hour Division. But only such contracts as provide workers shall not be employed more than 1,000 hours within a six-month period or 2,000 hours in a year are eligible to give employees permission to work up to 12 hours a day and 56 hours a week without special over-time compensation. Other labor contracts need not be filed by employers.

Time for Safety—Wage-Hour officials are anxious not to interfere with good safety practices and first-aid training. Soon after the promulgation of Interpretive Bulletin No. 13 that possible unfortunate consequence became evident. Revision was promptly promised; and much time was spent in June in working out a scheme to prevent Wage-Hour regulations from unduly burdening safety-first training. The new interpretation of June 16 will permit strictly voluntary participation in most first-aid and safety work by employees without putting this in the "hours worked" class of activity.

Phosphate Purchase—TVA has announced purchase of an additional phosphate rock acreage near Columbia, Tennessee, where 275 acres were procured at a reported price of $123,000. It is expected also that TVA will shortly announce plans for its new blast furnace to make phosphoric acid. The recent appropriation bill provided $450,000 for that purpose, and it is reported that construction will begin early in the present fiscal year near Franklin, Tennessee.

Goods Barter—The British did not want to trade tin and the Canadians did not want the British to trade for wheat. The treaty developed by Ambassador Kennedy therefore will provide that Uncle Sam furnish cotton in exchange for rubber. Tin wanted for military reserves must be bought with money from the strategics stock pile Act. But getting rubber in the trade will save the United States much cash spending, as rubber is one of the most important strategic materials. More of the cash remains, therefore, for other commodities, not only for tin but also for chromite, manganese, and many other commodities for which adequate domestic supplies are not available.

SHORTAGE OF QUALIFIED CHEMISTS BRINGS CHANGE IN GERMAN UNIVERSITY COURSES

From Our German Correspondent

THE present acute shortage of qualified chemists, following the post-war period when there was an oversupply of academically trained men, has led to a complete reorganization and unification of the study of chemistry in German universities and technical institutes. By a decree of April 6th, the Education Ministry has fixed the period of study at a minimum of seven semesters, to be concluded with the degree "Diplom-Chemiker." This is the first time that a degree for specialized chemical study has been granted at German universities. At the end of four semesters of study, candidates must pass a preliminary examination on general studies, and the last three semesters are to be devoted to work in a special field of chemistry, to be concluded with a written dissertation and an oral examination on all fields studied. Since students entering German universities have completed about sophomore work in American colleges, the new degree "Dipl.-Chem." will be roughly the equivalent of an American "M.A." degree.

The shortage of certified chemists is partly due to increased demands of new and expanded industries and partly to the reduction in the number of graduates available due to the discouragement of university study some five years ago and to the time students must spend in labor and army service. Illuminating in this connection is a survey just completed by the labor office in Leipzig of the occupational desires of male students who finished their secondary education in 1935 and in 1939. In 1935, 13 per cent of the graduates of secondary schools wanted to enter the technical sciences; in 1939, 25 per cent. In the same period the percentage desiring to study the medical and apothecary professions rose from 12 to 17 per cent. In 1935, 17 per cent wanted to enter the military profession, in 1936, 30 per cent, but by 1939 the ratio has declined to 17 per cent again. Interest in preparing for teaching, however, has declined from 17 to 6 per cent from 1935 to 1939, and interest in agricultural study from 4 to 1 per cent, and in theology from 6 to 1 per cent.

To secure a better utilization of funds and research facilities, the pharmaceutical divisions of 10 German universities and institutes have been disbanded. The facilities of the remaining 14 German and 3 Austrian universities with pharmacy schools will be strengthened, and should be capable of caring for the 1,700 students, which is estimated as the necessary number of supply apothecary and public health service positions. In 1937, 1,074 apothecaries were licensed, 27% of these being women; 3,880 doctors (671 women), and 57 food chemists, of whom 7 were women.

Results of the occupational census of May 17 should yield interesting figures for the chemical industry. The two previous post-war occupational censuses in 1925 and 1933 were taken in abnormal years and did not classify chemists carefully enough. In the 1939 census special care was taken to differentiate between trained chemists in industries, workers in industrial chemical plants, and laboratory chemists. Whereas the number of university trained chemists in Germany was estimated at 12,000 in 1938, the total number of employees in the industry rose from 295,000 at the low point in 1932 to a peak of 750,000 in 1938. 1938 also saw Germany take the lead in value of world chemical production with production worth 6,000 million RM, of which 750 million RM was exported.

"Dechema," the German society for chemical apparatus, with the Dechema, Achema and norm divisions, has moved its main offices from Berlin to the new Dechema-Haus, Bismarckallee, in Frankfurt. A branch office will be continued in the Haus of the Verein Deutscher Chemiker, where the headquarters have been located heretofore.

Of the various exhibitions and scientific congresses to be held in the near future, the national meeting of the Verein Deutscher Chemiker in Salzburg in September is attracting widespread attention. A number of grants to cover railway fare and hotel stay are being made by the Verein to enable younger chemists to attend the convention, which is being held in the former Austrian city. This is in keeping with a policy to hold conventions in Austria and Sudeten cities when possible to help acquaint Reich Germans with these areas and to help offset the losses in trade of these tourist centers.

A merger of several leading Austrian chemical plants, with the participation of I. G. Farben, into the Donau-Chemie A. G., Vienna, has just been effected. The new firm, the largest chemical enterprise in the Ostmark, (former Austria) includes the Skoda-Wetzler A. G., Wagenmann, Seybel & Co., carbide works Deutsch-Matrei A. G., the Bückl works, the fertilizer, sulphuric acid and chemical plant Deutsch-Wagram. The new enterprise has just laid the cornerstone of a sulphuric acid plant to be erected in Moosbierbaum.

A recent merger of international scope in the field of sulphur production has occurred with the transferring to the "Lurgi" company, Frankfurt, of rights to processes of SO_2 and S production from gases by the Metallgesellschaft, Frankfurt; Chemische Industrie, Basle, Switzerland; Sulphur Patents Ltd. of Imperial Chemical Industries Ltd., England; and Bolidens Gruvaktiebolag, Sweden.

Now that sufficient quantities of staple fiber are assured, attention is being concentrated on improvement in quality. New special types of cell wool are being developed, but it is still proving a difficult task to adapt the machinery of older textile processing plants to the new fiber. A model instructional and research plant devoted to the spinning of cell wool in Denkendorf, has been trying to coordinate the work of both producing and processing industries. The competition of new staple fibers has given the rayon industry a new stimulus and has also led to the development of natural fibers for more specialized purposes. The production of sheep's wool grew from 5,000 tons in 1932 to 7,400 in 1938, and it is hoped to boost this to 10- or 11,000 tons.

The erection of six new fiber board factories is planned for the near future. The production of fiber board, industrially applied on a large scale in the United States already in 1915, has assumed industrial importance in Germany only since 1932. The "fibroplast" process is mainly used in Germany, and wood and straw are the chief raw materials. At present there are nine larger factories and five smaller plants with an annual capacity of 30,000 tons of pressed board and 16,000 tons of insulating board. The construction of six additional plants should increase production to 75,000 tons. Heretofore the development of this industry has been held back to avoid competing with the veneer lumber industry.

A new "mineral wood" has been developed in Karlsruhe. Raw material consists of waste bark occurring in cellulose and tanning industries, and sawdust, as well as pumice, lava, and blast furnace slag. To increase elasticity and water-resistance, bituminous materials are added to the "mineral wood," which is produced in thin sheets. It can be used two days after production, chiefly as a floor covering or as wall board.

With the increased amount of slag resulting from growing iron and steel production and the utilizaiton of lower-grade ores (formerly 600 kgs. of slag resulted in producing 1 ton of raw iron; now the utilization of low grade domestic ores results in 1,000 kgs. or more). In 1938, one-fourth of the blast furnace slag was used for road paving, one-third for building and construction, and some as mine-filling, but one-third went unused to the slag heaps. 20 million tons of slag will result as a byproduct of iron and steel industries in 1940, and of this 7 million will go on the slag heaps unless some utilization is found. Considerable amounts of slag have been exported recently to Holland, which is poor in natural stone for building. It is estimated that fertilizer use of slag could reach 10 million tons.

Recent World Chemical Developments

Among recent world chemical developments, the Department of Commerce reports that China, prior to the outbreak of hostilities in the Orient, was a leading foreign market for American dyes, but since the beginning of 1938 shipments to that area have declined sharply. Dyes aggregating 6,000,000 lb. were exported from the United States to China in 1937. The total decreased to less than 2,000,000 lb. in 1938 and in the first quarter of the current year to only 210,000 lb.

Canada's chemical production was well maintained in 1938 with the value of the output at the factory recorded at $145,000,000, or only 2.6 per cent less than during the preceding year.

A well-known German chemical concern is reported to have developed an improved thermo-color process which employs metal salts as pigments incorporated in paints for determining temperature changes in motors and similar equipment which cannot be ascertained by the usual methods.

Japan's output of iodine from seaweed aggregated 47,660 kilograms in 1938 compared with 37,500 kilograms during the preceding year and 31,000 kilograms in 1936.

A.C.S. Will Meet in Boston In September

More than 4,000 persons, from every state and from many foreign countries, will attend the 15 half-day sessions of the American Chemical Society to be held from September 10 to 15 at Hotel Statler, Boston. Approximately 500 technical addresses will be given. Included in the program will be 13 symposia. There are 18 divisions within the Society. Each of these will have individual sessions, as well as participate in combined meetings.

Reichold Chemicals will Add New Phthalic Unit

Plans for the erection of a new phthalic anhydride plant have been announced by Reichold Chemicals, Inc. The existing phthalic plant of the company at Detroit has been in operation for the past year and the new unit will add an annual output of about 7,000,000 lb. to the present capacity. Reichold Chemicals, Inc. recently acquired the business of Fred L. Lavanburg of Brooklyn, long established as a manufacturer of dry colors.

Advertising Award to Frances M. Suarez

At the Thirty-Fifth Annual Convention of the Advertising Federation held in New York, June 19, a certificate of merit, being honorable mention for her contribution to advertising in 1938, was awarded to Miss Frances M. Suarez, advertising manager of the Philadelphia Quartz Co., Philadelphia. The entry consisted of a written exposition covering the work of Miss Suarez in 1938. Miss Suarez also is the contributor of the chapter on industrial advertising which appears in a book called "Advertising Careers for Women" which was published on June 8.

Calco Chemical Co. transforms colonial mansion into clubhouse
Left—"Phil's Hill" before remodeling. Right—The new clubhouse

Calco Capitalizing on Its Historical Setting

The world war plant of the Calco Chemical Co. at Bound Brook, N. J. is built on historic ground. The famous stage coach road known in Colonial days as The Old Yorke Road, extending from Philadelphia to Elizabeth, N. J. has suffered the fate of many such early roads and, at this point it now lies directly under the main buildings of the Calco company. Across the present road still stands one of the noted colonial mansions which during recent years has been allowed to slowly disintegrate and had reached a point where it was but a shell of its former glory. But it was a shell of sturdy framework with oaken beams impervious to the ravages of time.

With the expansion of the Calco enterprise an executives club house became a desirable addition to the plant facilities and instead of doing the obvious thing—building an ultra modern building—the Calco people decided to completely restore the famous landmark, known as "Phil's Hill" to its former glory, thus preserving for future generations a perfect example of colonial architecture and at the same time providing a delightful club house. Careful research guided the restoration of both house and grounds and the building now stands as a monument to its owners' pride in the glories of the early days of America. The land on which the house stands was purchased by Cornelius Van Horne in 1727. The house was built not long after. During the War for Independence it was used at different times as headquarters by both British and American officers. Light Horse Harry Lee was said to have ridden his horse through the wide colonial hall from the front to the back of the house.

Not far off, on the Heights of Middlebrook, a camp ground of the Continental Army, is the site where the American Flag was first officially raised over American forces in 1777.

Data and pictures from "Historic New Jersey In Pictures" by James S. Cawley, Princeton University Press.

Corning Develops New Heat Resisting Glass

A new process for the production of a heat resisting glass of thermal expansion so low that it approaches fused silica has been announced after an extensive developmental period by the Corning Glass Works, Corning, N. Y. The new glass is said to be capable of manufacture by mass production methods and so may be expected to find numerous applications which heretofore have not been open to glass. However, it is emphasized by the Corning management that the development is still in the pilot plant stage and that fully two years or more must pass before commercial development can be completed. Consequently, Corning is as yet unwilling to state for what particular uses the new ware is adapted.

Dr. Nordberg, one of the patentees of Corning's new low expansion glass, demonstrates with a ladle of molten iron and a cake of ice.

Although the ware can be formed by ordinary methods known to the glass industry, such as molding, blowing and pressing, a striking feature of the new process is that the treatment subsequent to the forming brings about a considerable change in composition, and a linear shrinkage of 13 per cent. On a volume basis the shrinkage is 35 per cent. The process as described in the patent issued to H. P. Hood and M. E. Nordberg, of the Corning research laboratories, and assigned to the company, consists in the formation of the desired object from certain original types of borosilicate glasses which are somewhat unstable. By means of heat treatment these glasses are separated into two phases, one high in silica and the other practically devoid of silica and soluble in the common acids. This second phase is then extracted by leaching, for example, with dilute nitric acid, so as to leave a skeleton-like structure of the high silica glass which contains some 96 per cent SiO_2. The surface of the object after this treatment feels rough, but not porous, to the touch. Nevertheless, it now contains some 36 per cent voids. The object is then fired at a vitrifying temperature to condense the structure and so produce a clear, solid mass which, as noted, has undergone a 13 per cent linear shrinkage in the process.

An important advantage of the new process is that the ware is formed, not at its high final vitrifying temperature, but rather at the comparatively low melting temperature of the original glass. It is claimed, therefore, that the new material can be produced at relatively low cost despite its final similarity to fused silica. As proof of the low expansion of the new ware it is pointed out that a vessel or other object can be brought to red heat, then plunged into ice water without danger of breakage, a performance which considerably surpasses the best of the low expansion glasses heretofore available.

Comparison of Physical Properties

	New Glass	Previous Low Expansion Glass	Fused Quarts
Softening point, deg. C..	1,442	819	1,667
Annealing point, deg. C..	931	553	1,140
Strain point, deg. C.....	857	510	1,070
Max. temp. for use for considerable time, deg. C.	900 to 1,000	500 to 600	1,100
Specific gravity.....	2.18	2.23	2.21
Coef. lin. expansion.....	7.8 to 8 x 10^{-7}	32 to 33 x 10^{-7}	5.5 to 5.85 x 10^{-7}

Different Factors Restrict Japanese Chemical Output

On the heels of the recent success of the Chosen Nitrogenous Explosives Co. in industrializing the manufacture of lead azide, the Japan Explosives Company announces that it has developed a process for the manufacture of the detonator and that it will shortly take up its commercial producion.

Under existing regulations, the manufacture of lead azide is not permitted in Japan proper, and unless the regulations be revised, the firm will be obliged to build its plant in Korea, Formosa or on one of the mandated South Sea islands.

The rigid restrictions on imports of raw materials and equipment, rising labor cost and the declining overseas market have placed many Japanese chemical concerns in a difficult position. Some of them have turned to the production of war chemicals, for which the demand seemed to be almost unlimited some time ago. However, this market is already fairly well supplied at present, and some manufacturers have gone farther into the field to keep themselves out of red ink.

The Teikoku Rayon Co., a ¥50-million concern, has started construction of a ¥3-million plant for the manufacture of aircraft parts at Marifumachi, Yamaguchi Prefecture, adjacent to the company's staple fiber plant.

Another example of the chemical firms' advance into the mechanical field is provided by the Suzuki Shoten, manufacturers of "Ajinomoto," Japan's world-famous glutenic acid food seasoning agent. This company recently acquired 20,000 shares in the Sato Mfg. Co., Ltd., manufacturers of machine tools and arms.

Investments of Japanese chemical industrial concerns in Manchukuo have become extremely active lately. The movement of Japanese capital into Manchukuo is being encouraged by both the Tokyo and Hsinking governments.

Some recent examples of Japanese business promotion in Manchuria are:

1. Large-scale expansion of the aluminum industry in Manchukuo with capital of the Manchuria Industrial Development Co. and of a Japanese banking syndicate, which supplied funds to Japanese chemical engineering firms.

2. Various electro-chemical enterprises sponsored by the Manchuria Electro-Chemical Co. with the financial backing of the Bridgestone Tyre Co. of Japan. As a joint enterprise of the two concerns, the Manchuria Synthetic Rubber Co., capitalized at ¥5,000,000, was recently organized for the production of synthetic rubber from carbide. The Electro-Chemical Industrial Co., a Japanese firm, has advanced to Manchukuo to produce carbide and nitrogen of lime, while the Dai Nippon Celluloid Co. has decided to take up the production of acetic acid.

CALENDAR

SEPT. 11-13, ELECTROCHEMICAL SOCIETY, fall meeting, Hotel Commodore, New York, N. Y.

SEPT. 11-15, AMERICAN CHEMICAL SOCIETY, fall meeting, Boston, Mass.

SEPT. 12-14, TECHNICAL ASSOCIATION OF THE PULP & PAPER INDUSTRY, fall meeting, Hotel Syracuse, Syracuse, N. Y.

NOV. 13-17, AMERICAN PETROLEUM INSTITUTE, annual meeting, Stevens Hotel, Chicago.

NOV. 15-17, AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, annual meeting, Providence-Biltmore Hotel, Providence, R. I.

DEC. 4-9, CHEMICAL EXPOSITION, Grand Central Palace, New York City.

PERSONALITIES

Greystone

Arthur Langmeier

✦ ARTHUR LANGMEIER has recently been named director of operations of the naval stores department of Hercules Powder Co. He will have charge of all manufacturing and development work at the plant, and naval stores work at the Experimental Station.

✦ L. H. LANGE of the Salt Lake City office of Booth Thompson Division of the Galigher Co., leaves to head the Johannesburg, South Africa, office and laboratory of the company.

✦ EDWARD R. WEIDLEIN, director Mellon Institute, Pittsburgh, delivered the commencement address at Waynesburg College, Waynesburg, Pa., on June 13, and subsequently that institution conferred on him the honorary degree of doctor of science.

✦ G. E. F. LUNDELL, chief, chemical division, National Bureau of Standards, has been elected vice-president of the American Society for Testing Materials. Dr. Lundell has been active in the affairs of this society and others in the country. Recently elected members of the executive committee are: J. J. Allen, chief chemist, Mechanical Rubber Goods Division, Firestone Tire & Rubber Co., Akron; R. D. Bonney, assistant manager of manufacturing, Congoleum-Nairn, Kearny, N. J.; T. S. Fuller, engineer of materials, General Electric Co., Schenectady; J. L. McCloud, chemist, Ford Motor Co., Dearborn, Mich. and M. A. Swayze, director of research, Lone Star Cement Corp., Upton, N. Y.

✦ WALTER F. PERKINS, vice-president of Koppers Co., in charge of its Baltimore operations, has been elected a member of the board of directors of that company.

✦ WILLIAM MERIAM BURTON, formerly president of the Standard Oil Co. of Indiana, and developer of the Burton petroleum cracking process, was awarded the honorary degree of doctor of science at the recent commencement of Western Reserve University. Dr. Burton is an alumnus of that university and Johns Hopkins.

✦ W. A. WESLEY of the International Nickel Co., research laboratory at Bayonne, N. J., was awarded the annual gold medal of the American Electro-Platers Society at its recent convention. The award was made in recognition of his paper on physical properties and uses of heavy nickel deposits.

✦ C. W. NICHOLS, SR., has been elected to the presidency of the Nichols Engineering & Research Corp. He succeeds H. J. Hartley who resigned recently.

✦ WARREN R. SMITH, for 43 years head of the department of chemistry, Lewis University of Chicago, Ill., retired at the end of the school year. He is succeeded by Prof. L. F. Supple.

✦ J. EHRLICH is constructing a consulting chemical laboratory in Beverley Hills, Calif. It is in fulfillment of a long wish on the part of Dr. Ehrlich to carry on his chemical research in California.

✦ H. L. BAKER, a chemical engineer for the American Blower Corp., has been elected president of the Junior Chemical Engineers of New York. Other officers include M. E. Clark, assistant editor of *Chem. & Met.*, vice president; P. S. Otten, secretary and R. P. Devoluy, treasurer.

✦ WALLACE P. COHOE has been elected chairman of the American Section of the Society of Chemical Industries for the year 1939-40. Other officers include Lincoln T. Work, vice-chairman, C. S. Kimball, honorary secretary and J. W. H. Randall, honorary treasurer.

✦ ANTON B. BURG has resigned his position as research instructor at the University of Illinois, to accept a position as assistant professor at the University of Southern California, Los Angeles.

✦ DR. HERBERT C. BROWN has been appointed to fill the vacancy left by Dr. Burg at the University of Illinois.

✦ WAYNE W. MARSHALL has accepted an appointment as assistant professor of analytical chemistry at the University of South Dakota.

✦ F. O. GREEN of Northwestern University has been appointed to the chemical department at Greenville College in Greenville, Ill.

✦ WILLIAM W. SKINNER has been appointed associate chief of the Bureau of Agricultural Chemistry and Engineering.

Willard Henry Dow

✦ WILLARD HENRY DOW, president and general manager of the Dow Chemical Co., Midland, Mich., received the honorary degree of doctor of science from Michigan College of Mining and Technology on June 2, and delivered the graduation address. Dr. Dow was presented for his degree by Dr. C. M. Carson, head of the department of chemistry and chemical engineering of the College.

✦ R. O. HULL of E. I. du Pont de Nemours & Co. has been awarded the Proctor Memorial prize by the American Electro-Platers Society.

✦ ERNEST B. BENGER has been appointed assistant manager of the rayon department technical division of E. I. du Pont de Nemours & Co.

✦ COLE COOLIDGE has been appointed assistant director of the du Pont company in place of Dr. Benger.

✦ C. H. GREENEWALT, a research supervisor of the Chemical Department Experimental Station of du Pont will succeed Dr. Coolidge.

✦ MORRIS E. LEEDS, president of the Leeds & Northrup Co. assumes the position of chairman of the Board of Directors, and C. S. Redding, vice-president becomes president.

✦ MELVIN C. MOLSTAD, of the chemical engineering staff at Yale University, has been appointed associate professor in charge of chemical engineering at the University of Pennsylvania.

Chemical ECONOMICS and MARKETS

INDEX FOR CONSUMPTION OF CHEMICALS ON RISING TREND

CONSUMPTION of chemicals in June was variously affected by seasonal influences with losses in the use of sulphuric acid and other chemicals in the fertilizer trade more than offset by the increased movement of agricultural and insecticide chemicals, enlarged operations at rayon plants, and continued activity in automotive and paint and varnish plants. Steel mills also speeded up schedules and the flow of petroleum to refining stills held a relatively high average daily rate.

The preliminary index of *Chem. & Met.* places the index for chemical consumption for June at 116.00 which compares with a revised index of 115.65 for May and 113.91 for April. For 1938, the May index was 98.33 and that for June, 92.92. For the first half of this year, the indexes record a total consumption of chemicals of more than 18 per cent above that for the like period of last year.

Chem. & Met. Index for Consumption of Chemicals

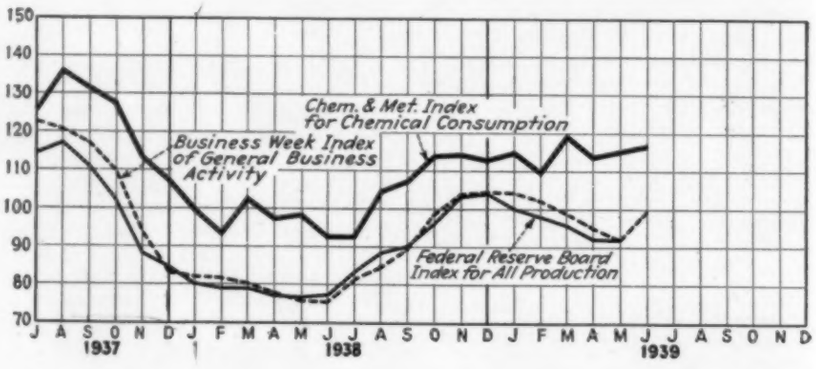
	April Revised	May
Fertilizer	23.09	22.55
Pulp and paper	15.53	14.80
Glass	11.30	12.13
Petroleum refining	12.96	13.73
Paint and varnish	11.06	13.59
Iron and steel	6.58	6.06
Rayon	8.36	7.92
Textiles	6.88	7.46
Coal products	5.91	4.93
Leather, glue and gelatin	4.05	3.80
Explosives	3.84	4.28
Rubber	2.51	2.52
Plastics	1.84	1.88
	113.91	115.65

Wide variations are noted in the rate of change for the six-month period and it follows that there were sharp differences in the extent to which the individual chemicals gained ground in the present year. The fertilizer industry was the only one which is included in the index which failed to improve its position in the six months. Fertilizer consumption of sulphuric acid and other chemicals apparently fell about 2.5 per cent below the level reached in the first half of 1938.

Percentage increases for the other consuming industries over the six-month periods were as follows: pulp and paper, 17; glass and ceramics, 35; petroleum refining, 2.5; paint and varnish, 11.5; iron and steel, 27; rayon, 79; textiles, 39; coal products, 23.5; leather, glue and gelatine, 20; explosives, 35.5; rubber, 67; and plastics, 70.

Final data for operations in May showed that superphosphate production ran counter to the seasonal expectancy and the output for that month actually was not much lower than for April. Lower operating schedules, however, have since gone into effect and a falling trend is expected for the next two or three months. Glass container production was on the up trend and may not fall off materially but some branches of the glassware division are reported to have curtailed work since the turn of the present month. Unofficial figures credit sales of paint and varnish with maintaining a high average to date. Automotive schedules have been cut this month and the present month may see the lowest turnout of units for the year. Shipments of rayon yarn have run in excess of production in recent months and this has had the effect of increasing the daily rate of output both for yarn and staple. In the textile industry, the movement of silk to mills is still on a reduced scale but cotton, wool, and rayon consumption has held on a high plane. The action of southern mills in putting into effect a cut of 25 per cent in print mill products does not appear to have much influence as yet.

Based on reports from 1,619 manufacturers representing all sections of the country, the Bureau of the Census reports that manufacturers' sales in May were 4.7 per cent above those for the preceding month and 19.2 per cent higher than in May 1938.

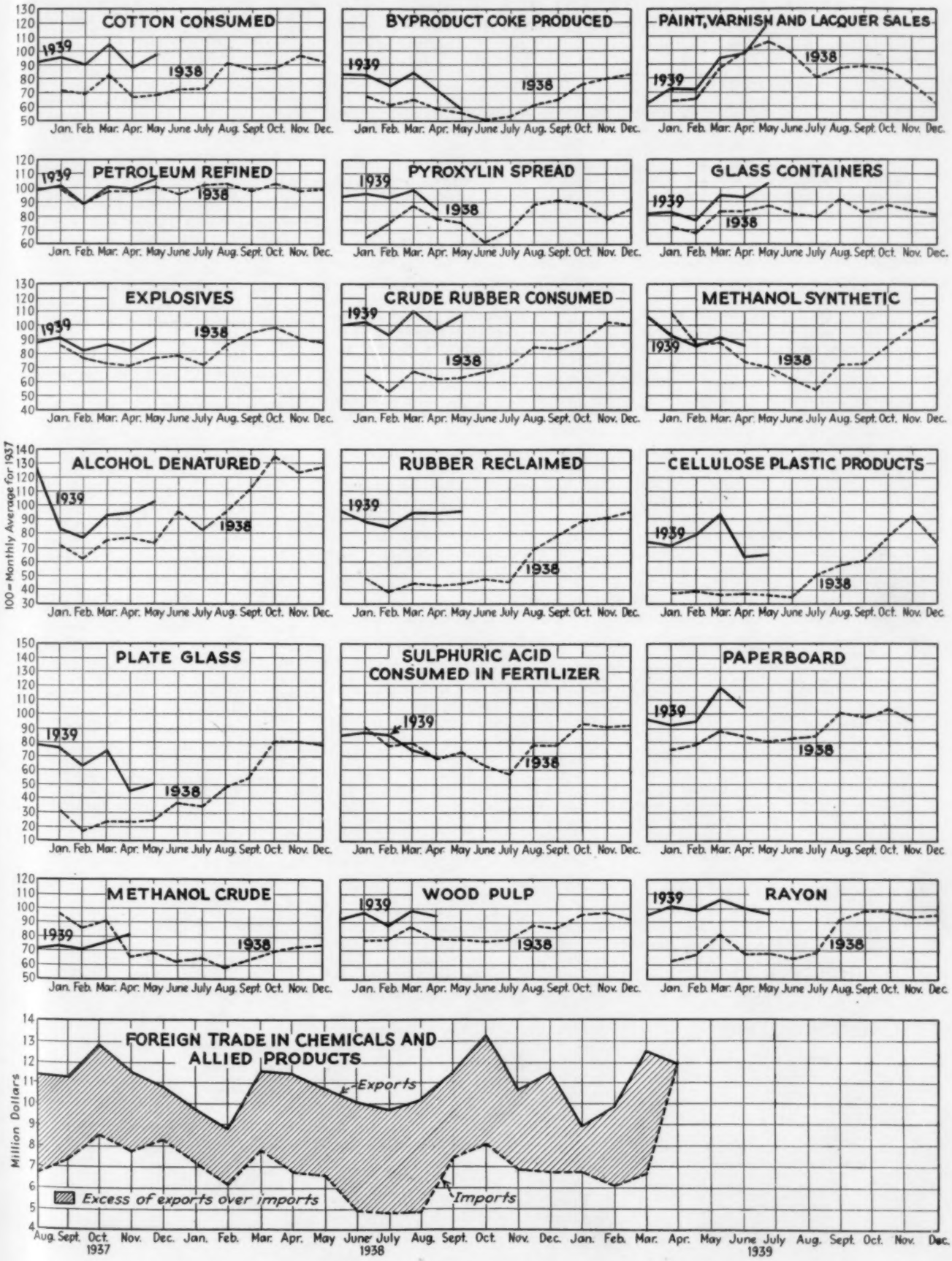


Percentage gains for specified groups over May 1938 and April 1939 were as follows: chemicals and allied products, 20.7 per cent and 12.6 per cent; paints and varnishes, 19.5 per cent and 24.8 per cent; pharmaceuticals and proprietary medicines, 24.9 per cent and 3.4 per cent; other chemical products, 20.8 per cent and 8.8 per cent; textiles and products, 20 per cent and 1.6 per cent; paper and products, 10.6 per cent and 6.4 per cent.

Production and Consumption Data for Chemical-Consuming Industries

	May 1939	May 1938	January-May 1939	January-May 1938	Per cent of gain for 1939
Production					
Alcohol, ethyl, 1,000 pr. gal	18,655	14,253	85,675	77,771	10.2
Alcohol denatured, 1,000 wi. gal	8,490	6,092	37,107	29,557	25.6
Ammonia, liquor, 1,000 lb	3,426	3,263	20,057	17,573	14.1
Ammonium sulphate, 1,000 lb	66,129	64,004	413,810	348,287	18.8
Benzol, 1,000 gal	5,456	4,905	35,261	28,018	25.8
Byproduct coke, 1,000 tons	2,396	2,283	15,194	12,650	20.1
Glass containers, 1,000 gr	4,516	3,837	19,694	17,241	14.2
Plate glass, 1,000 sq. ft	8,036	3,866	49,545	19,271	157.1
Nitrocellulose plastics, 1,000 lb	1,036	668	5,440	3,434	58.4
Cellulose acetate plastics					
Sheets, rods, and tubes, 1,000 lb	491	258	3,961	1,357	191.9
Molding composition, 1,000 lb	704	435	3,566	2,085	71.0
Pyroxyln spread, 1,000 lb	4,727	4,129	25,121	20,938	20.0
Rubber reclaimed, tons	14,769	7,420	70,680	34,371	105.6
Consumption					
Cotton, bales	605,353	426,149	2,955,576	2,212,060	33.6
Silk, bales	26,150	28,687	165,850	157,927	5.0
Explosives, sales, 1,000 lb	29,315	24,904	139,306	123,651	12.7
Rubber, crude, tons	44,377	30,753	227,307	142,521	59.5
Automobiles, factory sales, no	297,508	192,059	1,643,813	1,028,223	57.0

Production and Consumption Trends



LARGER TONNAGE MOVEMENT OF CHEMICALS REPORTED FOR LAST MONTH

MANY consuming industries operated more extensively last month with a consequent improvement in the tonnage movement of important chemicals. Mineral acids, alkalis, acetic anhydride, carbon bisulphide, and copper sulphate were included among the selections for which greater activity was reported. More recently a falling off has been reported for fertilizer chemicals and steel makers also have cut down their raw material requirements.

Prices for the majority of heavy chemicals remain on an unchanged basis as has been the case for a long time. Occasionally a revision in sales schedules is announced and in the last month the most important development in that line was found in the cases of lithopone and titanium oxides, which were reduced in price. There also were changes in buyers favor in some of the fertilizer chemicals where new contract schedules were announced for forward deliveries. Only minor revisions were made in the coal-tar list but there are rumors that enlarged production of phenol might act as a factor in lowering values proved to have been verified.

Values for oils and fats took a two-fold course with linseed oil holding steady and with trading in China wood oil restricted by the scarcity of offerings. The high price quoted for China wood oil has directed attention toward other drying oils but stocks of such oils as oiticica and perilla have not been large enough to satisfy consuming needs and the increased inquiry for them has served to elevate prices. The lard market has been easy, in fact animal fats as a group have shown a declining trend and this has affected adversely values for most of the edible vegetable oils which are of competitive nature.

Effective July 14 the Customs Bureau has instructed collectors to assess duty at 7c. per lb. and 40 per cent upon imports of ethyl ester of tropic acid not suited in its condition at time of entry for use as a medicine. It is held to be a coal-tar product and not a medicinal preparation.

Superphosphate production in May was somewhat lower than in April, but there is usually a big decline between these two months. Output in May in plants which report to The National Fertilizer Association totaled 241,000 tons, which compares with 239,500 tons in May of last year. A decline in the northern area was more than offset by an increase in the south. In the first five months of the year total production was moderately lower than in the corresponding period of 1938, the drop amounting to only about 2 per cent. Production last fall was well below the preceding fall season, however, so that the tonnage produced in the first 11 months of the current fiscal year, from July through May, was 13 per cent lower than in the year previous.

Despite a sharp decrease in the usual monthly shipments of sulphur to foreign markets, exports of chemicals and related products continued at very high levels in May, with practically all other items entering into the list recording substantial gains according to the Department of Commerce.

The aggregate value of exports of such products in May was $15,000,000, compared with $14,600,000 during the preceding month and $13,204,000 in May 1938. Comparing May of the current year with the corresponding month of 1938 a number of substantial gains are shown, particularly with chemical specialties, a classification which includes a number of high grade specialty products.

Other items of chemical and related products recording gains in May compared with the corresponding month of 1938 included naval stores, exports of which increased in value from $1,080,000 to $1,100,600; crude drugs, from $78,500 to $87,500; vegetable tanning materials, from $93,000 to $132,500; coal-tar products, from $980,000 to $1,087,700; industrial chemicals, from $2,088,500 to $2,467,500; essential oils, from $184,000 to $225,000; paint products, from $1,715,000 to $1,825,000; and toilet preparations, from $485,000 to $523,000.

Although lower than in April, imports of chemicals and related products continued at high levels in May and were more than 30 per cent above imports of such products during May 1938.

Except for coal-tar products, all leading items classified as chemicals and related products were imported in larger quantities during May compared with the corresponding month of 1938, particularly drying oils and drying oil seeds.

Sharp increases were also recorded in imports of industrial chemicals in May during which they were valued at $2,524,000 against $1,188,000 in May 1938, the increase being due largely to heavier foreign purchases of ammonium chloride and barium compounds. Fertilizer materials were also received in larger quantities during the month, in which a total of 138,477 tons valued at $3,479,000 were imported against 125,150 tons valued at $2,879,500 in May 1938.

When South, Carolina, this month passed a law requiring that nitrogen-bearing fertilizers be guaranteed and sold on the basis of their nitrogen content rather than their ammonia content it became the forty-seventh State to enact a similar law. This makes all the States in the Union having fertilizer control laws uniform on this point.

Many producers of raw materials carrying nitrogen already handle their transactions in terms of nitrogen, and practically all other producers of nitrogen carriers have indicated their willingness to carry on their advertising and selling on a nitrogen basis after June 30. The National Fertilizer Association at its convention June 7 passed a resolution repeating its recommendation of previous years that this change be made in terminology.

The achievement of this uniformity of terms is the culmination of a number of years' work on the part of agronomists, agricultural chemists, State officials, and members of the fertilizer industry who sought the accuracy and simplicity which this regulation brings about.

Nitrogen contained in fertilizer materials is chemically combined in a number of forms, and the only common denominator of all these chemical compounds is the elment nitrogen. By stating the nitrogen content in terms of nitrogen, no matter what its source, the dual statements of guarantee are eliminated and with them much confusion and misunderstanding.

CHEM. & MET.

Weighted Index of

CHEMICAL PRICES

Base=100 for 1937

This month	**97.02**
Last month	97.21
July, 1938	99.91
July, 1937	100.14

New contract prices showed some declines in quotations for important fertilizer chemicals although some of them carry automatic monthly advances. Lithopone was among the important materials for which lower prices went into effect.

CHEM. & MET.

Weighted Index of Prices for

OILS AND FATS

Base=100 for 1937

This month	**70.33**
Last month	71.09
July, 1938	76.11
July, 1937	94.39

The paint-making oils were firm with advances for some selections. Other oils and fats, however, were lowered in price. The nominal position in China wood oil has increased demand for competing oils. Weakness in animal fats brought price recessions in edible oils.

INDUSTRIAL CHEMICALS

Current PRICES

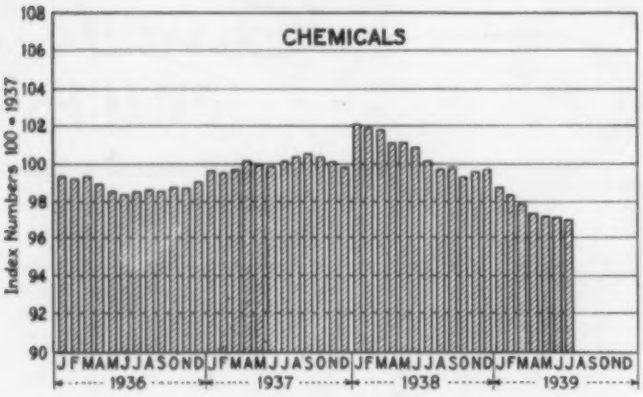
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.05½–$0.06½	$0.05½–$0.06½	$0.05½–$0.06½
Acid, acetic, 28%, bbl., cwt.	2.23 – 2.48	2.23 – 2.48	2.23 – 2.48
Glacial 99%, drums	8.43 – 8.68	8.43 – 8.68	8.43 – 8.68
U. S. P. reagent	10.25 –10.50	10.25 –10.50	10.25 –10.50
Boric, bbl., ton	106.00–111.00	106.00–111.00	105.00–115.00
Citric, kegs, lb	.20 – .23	.20½– .23	.23½– .26
Formic, bbl., ton	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb	.70 – .75	.70 – .75	.70 – .75
Hydrofluoric 30% carb., lb	.07 – .07½	.07 – .07½	.07 – .07½
Lactic, 44%, tech., light, bbl., lb	.06½– .06¾	.06½– .06¾	.06½– .06¾
Muriatic, 18°, tanks, cwt.	1.05 –.....	1.05 –.....	1.05 –.....
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –.....	18.50 –20.00
Oxalic, crystals, bbl., lb.	.10½– .12	.10½– .12	.10½– .12
Phosphoric, tech., c'bys., lb.	.07½– .08½	.07½– .08½	.09 – .10
Sulphuric, 60° tanks, ton	13.00 –.....	13.00 –.....	13.00 –.....
Sulphuric, 66°, tanks, ton	16.50 –.....	16.50 –.....	16.50 –.....
Tannic, tech., bbl., lb.	.40 – .45	.40 – .45	.40 – .45
Tartaric, powd., bbl., lb.	.27½–.....	.27½–.....	.27½–.....
Tungstic, bbl., lb.	2.35 –.....	2.35 –.....	2.75 –.....
Alcohol, Amyl	.....	.....	.....
From Pentane, tanks, lb.	.101–.....	.101–.....	.123–.....
Alcohol, Butyl, tanks, lb.	.07 –.....	.07½–.....	.08½–.....
Alcohol, Ethyl, 190 p'f., bbl., gal.	4.54 –.....	4.54 –.....	4.14 –.....
Denatured, 190 proof	.....	.....	.....
No. 1 special, bbl., gal. wks.	.26½–.....	.26½–.....	.31 –.....
Alum, ammonia, lump, bbl., lb.	.03½– .04	.03½– .04	.03 – .04
Potash, lump, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Aluminum sulphate, com. bags, cwt.	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt.	1.30 – 1.55	1.30 – 1.55	1.30 – 1.55
Aqua ammonia, 26°, drums, lb.	.02 – .03	.02 – .03	.02½– .03
tanks, lb.	.02 – .02½	.02 – .02½	.02½– .02½
Ammonia, anhydrous, cyl., lb.	.15½–.....	.15½–.....	.15½–.16
tanks, lb.	.04½–.....	.04½–.....	.04½–.16
Ammonium carbonate, powd. tech., casks, lb.	.08 – .12	.08 – .12	.08 – .12
Sulphate, wks, cwt.	1.40 –.....	1.40 –.....	1.325–.....
Amylacetate tech., tanks, lb.	.10½–.....	.10½–.....	.11 –.....
Antimony Oxide, bbl., lb	.10 – .11	.11 – .12	.11½– .12
Arsenic, white, powd., bbl., lb.	.03 – .03½	.03 – .03½	.03 – .03½
Red, powd., kegs, lb	.15½– .16	.15½– .16	.15½– .16
Barium carbonate, bbl., ton	52.50 –57.50	52.50 –57.50	52.50 –57.50
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb.	.07 – .08	.07 – .08	.07 – .08
Blanc fixe, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f. o. b., wks., drums, cwt.	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton	48.00 –51.00	48.00 –51.00	48.00 –51.00
Bromine, cs., lb.	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	1.65 –.....	1.65 –.....	1.65 –.....
Arsenate, dr., lb.	.06½– .07	.06½– .07	.06½– .07
Carbide drums, lb.	.05 – .06	.05 – .06	.05 – .06
Chloride, fused, dr., del., ton	21.50 –24.50	21.50 –24.50	21.50 –24.50
flake, dr., del., ton	23.00 –25.00	23.00 –25.00	23.00 –25.00
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05 – .06	.05 – .06	.05 – .06
Tetrachloride drums, lb	.04½– .05½	.04½– .05½	.05½– .06
Chlorine, liquid, tanks, wks., lb.	1.75 –.....	1.75 –.....	2.15 –.....
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.67 – 1.70	1.67 – 1.70	1.67 – 1.70
Copperas, bgs., f. o. b., wks., ton	15.00 –16.00	15.00 –16.00	15.00 –16.00
Copper carbonate, bbl., lb.	.10 – .16½	.10 – .16½	.09 – .16
Sulphate, bbl., cwt.	4.25 – 4.50	4.10 – 4.35	4.15 – 4.40
Cream of tartar, bbl., lb.	.22½– .23	.22½– .23	.21½– .22
Diethylene glycol, dr., lb.	.22 – .23	.22 – .23	.22 – .23
Epsom salt, dom., tech., bbl., cwt.	1.80 – 2.00	1.80 – 2.00	1.80 – 2.00
Ethyl acetate, drums, lb.	.061–.....	.061–.....	.06½–.....
Formaldehyde, 40%, bbl., lb.	.05½– .06¼	.05½– .06¼	.05½– .6½
Furfural, tar ks, lb.	.09 –.....	.09 –.....	.09 –.....
Fusel oil, ref. drums, lb.	.12½– .14	.12½– .14	.12½– .14
Glaubers salt, bags, cwt.	.95 – 1.00	.95 – 1.00	.95 – 1.00
Glycerine, c.p., drums, extra, lb.	.12½–.....	.12½–.....	.16½–.....
Lead:			
White, basic carbonate, dry casks, lb.	.07 –.....	.07 –.....	.06½–.....
White, basic sulphate, sck., lb.	.06½–.....	.06½–.....	.06½–.....
Red, dry, sck., lb.	.0735–.....	.07½ –.....	.074–.....
Lead acetate, white crys., bbl., lb.	.10 – .11	.10 – .11	.10 – .11
Lead arsenate, powd., bbl., lb.	.10 – .10½	.10 – .10½	.12½– .13
Lime, chem., bulk, ton	8.50 –.....	8.50 –.....	8.50 –.....
Litharge, pwd., csk., lb.	.06½–.....	.06½–.....	1.05½–.....
Lithophone, bags, lb.	.04 – .04½	.04½– .04¾	.04½– .05
Magnesium carb., tech., bags, lb.	.06 – .06½	.06 – .06½	.06 – .06½
Methanol, 95%, tanks, gal.	.31 –.....	.31 –.....	.31 –.....
97%, tanks, gal.	.32 –.....	.32 –.....	.32 –.....
Synthetic, tanks, gal.	.33 –.....	.33 –.....	.33 –.....
Nickel salt, double, bbl., lb.	.13 – .13½	.13 – .13½	.13 – .13½
Orange mineral, csk., lb.	.10½–.....	.10½–.....	.10½–.....
Phosphorus, red, cases, lb.	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb.	.18 – .25	.18 – .25	.24 – .30
Potassium bichromate, casks, lb.	.08½– .09	.08½– .09	.08½– .09
Carbonate, 80–85%, calc. csk., lb.	.06½– .07	.06½– .07	.06½– .07
Chlorate, powd., lb.	.09½–.....	.09½–.....	.09½–.....
Hydroxide (c'stic potash) dr., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Muriate, 80% bgs., unit.	.53½–.....	.53½–.....	.53½–.....
Nitrate, bbl., lb.	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.18½– .19	.18½– .19	.18½– .19
Prussate, yellow, cake, lb.	.14 – .15	.14 – .15	.15 – .16
Sal ammoniac, white, casks, lb.	.05 – .05½	.05 – .05½	.05 – .05½
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	13.00 –15.00	13.00 –15.00	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt.	1.05 –.....	1.05 –.....	1.05 –.....
Dense, bags, cwt.	1.10 –.....	1.10 –.....	1.10 –.....
Soda, caustic, 76%, solid, drums, cwt.	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, works, bbl., lb.	.04 – .05	.04 – .05	.04½– .05
Bicarbonate, bbl., cwt.	1.70 – 2.00	1.70 – 2.00	1.75 – 2.00
Bichromate, casks, lb.	.06½– .07	.06½– .07	.06½– .07
Bisulphate, bulk, ton	15.00 –16.00	15.00 –16.00	15.00 –16.00
Bisulphite, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Chlorate, kegs, lb.	.06½– .06¾	.06½– .06¾	.06½– .06¾
Cyanide, cases, dom., lb.	.14 – .15	.14 – .15	.16½– .17
Fluoride, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Hyposulphite, bbl., cwt.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	2.20 – 3.20	2.20 – 3.20	2.15 – 3.15
Nitrate, bags, cwt.	1.35 –.....	1.45 –.....	1.45 –.....
Nitrite, casks, lb.	.06½– .07	.06½– .07	.07 – .08
Phosphate, dibasic, bags, lb.	1.85 –.....	1.85 –.....	1.85 – .024
Prussiate, yel. drums, lb.	.09½– .10	.09½– .10	.10 – .11
Silicate (40° dr.) wks., cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr., lb.	.02½– .03½	.02½– .03	.02½– .03
Sulphite, crys., bbl., lb.	.02½– .02½	.02½– .02½	.02½– .02½
Sulphur, crude at mine, bulk, ton	16.00 –.....	16.00 –.....	18.00 –.....
Chloride, dr., lb.	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb.	.07 – .08	.07 – .08	.07 – .07½
Flour, bag, cwt.	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb.	.52 –.....	.52 –.....	.44 –.....
Crystals, bbl., lb.	.38 –.....	.38 –.....	.35 –.....
Zinc chloride, gran., bbl., lb.	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl., lb	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb.	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb.	.06½–.....	.06½–.....	.06½–.....
Zinc oxide, lead free, bag., lb.	.06½–.....	.06½–.....	.06½–.....
5% lead sulphate, bags, lb.	.06½–.....	.06½–.....	.06½–.....
Sulphate, bbl., cwt.	2.75 – 3.00	2.75 – 3.00	3.15 – 3.60

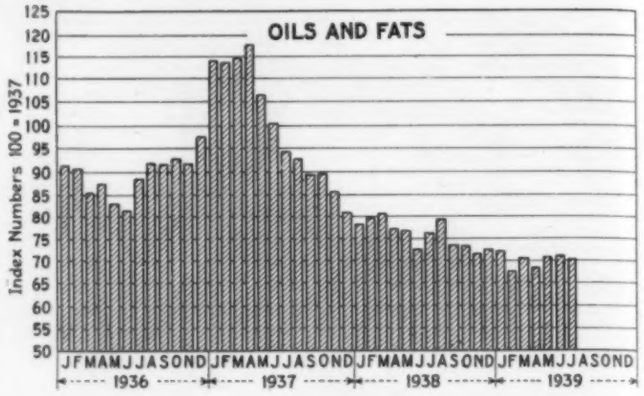
OILS AND FATS

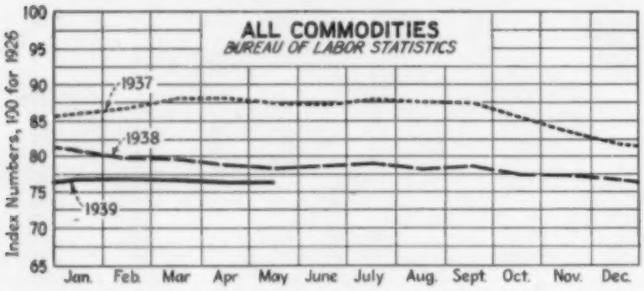
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb.	$0.08½–$0.10	$0.08½–$0.10	$0.09½–$0.10
Chinawood oil, bbl., lb.	.22 –.....	.20 –.....	.12½–.....
Coconut oil, Ceylon, tank, N. Y., lb.	.03 –.....	.03½–.....	.03¾–.....
Corn oil crude, tanks (f. o. b. mill), lb.	.05½–.....	.05¾–.....	.07½–.....
Cottonseed oil, crude (f. o. b. mill), tanks, lb.	.05½–.....	.05½–.....	.07 –.....
Linseed oil, raw car lots, bbl., lb.	.091–.....	.091–.....	.086–.....
Palm, casks, lb.	.03½–.....	.03¾–.....	.04 –.....
Peanut oil, crude, tanks (mill), lb.	.05½–.....	.05½–.....	.07½–.....
Rapeseed oil, refined, bbl., gal.	.80 –.....	.80 –.....	.75 –.....
Soya bean, tank, lb.	.04½–.....	.04¾–.....	.06 –.....
Sulphur (olive foots), bbl., lb.	.06½–.....	.06¾–.....	.07½–.....
Cod, Newfoundland, bbl., gal.	.32 –.....	.32 –.....	.50 –.....
Menhaden, light pressed, bbl., lb.	.064–.....	.066–.....	.069–.....
Crude, tanks (f. o. b. factory), gal.	.26 –.....	.28 –.....	.27 –.....
Grease, yellow, loose, lb.	.04½–.....	.04¾–.....	.04½–.....
Oleo stearine, lb.	.06 –.....	.06 –.....	.07½–.....
Oleo oil, No. 1	.06¾–.....	.07½–.....	.09 –.....
Red oil, distilled, d.p. bbl., lb.	.07½–.....	.07¾–.....	.08½–.....
Tallow extra, loose, lb.	.04½–.....	.05½–.....	.05½–.....

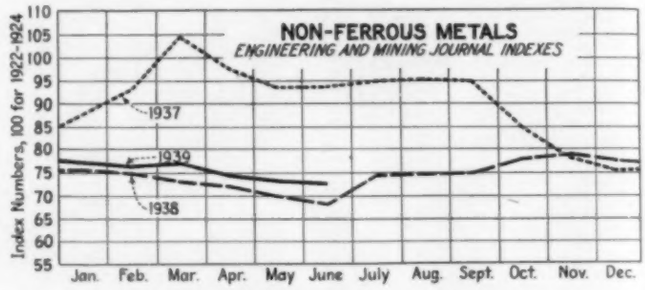
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to July 14

Chem. & Met.'s Weighted Price Indexes









COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb.	$0.52 –$0.55	$0.52 –$0.55	$0.52 –$0.55
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.15 – .16	.15 – .16	.15 – .16
Aniline, salts, bbl., lb.	.22 – .24	.22 – .24	.22 – .24
Benzaldehyde, U.S.P., dr., lb.	.85 – .95	.85 – .95	.85 – .95
Benzidine base, bbl., lb.	.70 – .75	.70 – .75	.70 – .75
Benzoic acid, U.S.P., kgs., lb.	.54 – .56	.54 – .56	.54 – .56
Benzyl enloride, tech., dr., lb.	.23 – .25	.23 – .25	.25 – .27
Benzol, 90%, tanks, works, gal.	.16 – .18	.16 – .18	.16 – .18
Beta-napthol, tech., drums, lb.	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb.	.09½– .10	.10 – .11	.10½– .11
Cresylic acid, dr., wks., gal.	.55 – .57	.69 – .71	.78 – .80
Diethylaniline, dr., lb.	.40 – .45	.40 – .45	.40 – .45
Dinitrophenol, bbl., lb.	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluen, bbl., lb.	.15 – .16	.15 – .16	.15 – .16
Dip oil, 15%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb.	.32 – .36	.32 – .36	.32 – .36
H-acid, bbl., lb.	.50 – .55	.50 – .55	.50 – .55
Naphthalene, flake, bbl., lb.	.05½– .06	.05½– .06	.06½– .07
Nitrobensene, dr., lb.	.08 – .09	.08 – .09	.08 – .09
Para-nitraniline, bbl., lb.	.47 – .49	.47 – .49	.50 – .52
Phenol, U.S.P., drums, lb.	.13 –.....	.14½–.....	.14½–.....
Picric acid, bbl., lb.	.35 – .40	.35 – .40	.35 – .40
Pyridine, dr., gal.	1.55 – 1.60	1.55 – 1.60	1.55 – 1.60
Resorcinal, tech., kegs, lb.	.75 – .80	.75 – .80	.75 – .80
Salicylic acid, tech., bbl., lb.	.33 – .40	.33 – .40	.33 – .40
Solvent naptha, w.w., tanks, gal.	.26 –.....	.26 –.....	.26 –.....
Tolidine, bbl., lb.	.86 – .88	.86 – .88	.88 – .90
Toluene, tanks, works, gal.	.27 –.....	.27 –.....	.26 –.....
Xylene, com, tanks, gal.	.26 –.....	.26 –.....	.26 –.....

MISCELLANEOUS

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech., bbl., lb.	.09 – .11	.08½– .11	.08 – .10½
China clay, dom., f.o.b. mine, ton.	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors			
Carbon gas, black (wks.), lb.	.02½– .30	.02½– .30	.02½– .30
Prussian blue, bbl., lb.	.36 – .37	.36 – .37	.36 – .37
Ultramarine blue, bbl., lb.	.10 – .26	.10 – .26	.10 – .26
Chrome green, bbl., lb.	.21 – .30	.21 – .30	.21 – .27
Carmine red, tins, lb.	4.35 – 4.40	4.35 – 4.40	4.00 – 4.40
Para toner, lb.	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb.	1.57 – 1.58	1.57 – 1.58	1.45 – 1.50
Chrome yellow, C.P., bbl., lb.	.14½– .15½	.14½– .15½	.14½– .15½
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.06 – .06½	.06 – .06½	.06 – .06½
Gum copal Congo, bags, lb.	.06 – .30	.06 – .30	.06 – .30
Manila, bags, lb.	.07 – .14	.07 – .14	.09 – .14
Damar, Batavia, cases, lb.	.07½– .20	.07½– .20	.08 – .24
Kauri cases, lb.	.17½– .60	.17½– .60	.18½– .60
Kieselguhr (f.o.b. N. Y.), ton.	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton	50.00 –.....	50.00 –.....	50.00 –.....
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	.03 – .04	.03 – .04	.03 – .04
Rosin, H., bbl.	6.40 –.....	6.35 –.....	6.10 –.....
Turpentine, gal.	.30 –.....	.29½–.....	.29 –.....
Shellac, orange, fine, bags, lb.	.19 –.....	.19 –.....	.20 –.....
Bleached, bonedry, bags, lb.	.18 –.....	.18 –.....	.18 –.....
T. N. Bags, lb.	.09½–.....	.10 –.....	.11 –.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 –10.00	7.50 –10.00	7.50 –11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 –.....	13.75 –.....	13.75 –.....

INDUSTRIAL NOTES

PRESSED STEEL TANK CO., Milwaukee, has appointed Norman A. Evans sales manager with headquarters in the home office.

TWIN DISC CLUTCH CO., Racine, Wisc., has appointed the Link-Belt Co., Chicago and Philadelphia, as distributor.

BUFFALO FOUNDRY & MACHINE CO., Buffalo, has opened a new branch office in the Keith Bldg., Cleveland, with Malcolm S. Adler in charge.

ALLEGHENY LUDLUM STEEL CORP., Pittsburgh, has moved W. L. Weaver from Watervliet, N. Y., to Springfield, Mass., where he will act as district sales manager of the New England territory.

HAGAN CORP., Pittsburgh, has appointed D. J. Erikson vice-president in charge of sales for the Hagan Corp. and its subsidiaries, Hall laboratories, Inc., The Buromin Co., and Calgon, Inc.

LINCOLN ELECTRIC RAILWAY SALES CO., Cleveland, has appointed Thomas V. Brooke as sales engineer in its Chicago office.

WHEELCO INSTRUMENTS CO., Chicago, is now represented in Houston, Texas, by the Industrial Equipment Co., and in New Orleans by Frank P. Fischer, 1608 Audubon St.

LEGRAND BLEACH CORP., 111 49th St., Brooklyn, N. Y., has changed its corporate name to Legrand Chemical Corp., the officers and personnel remaining unchanged. The offices and plant will be moved to 103 50th St.

AMERICAN ENGINEERING CO., Philadelphia, is now represented in the metropolitan New York territory by A. C. Cooper Sales Co., 220 E. 42d St.

AMERICAN MAIZE-PRODUCTS CO., New York, has appointed Paul Prentiss assistant district sales manager of the bulk sales division for northern Pennsylvania and upper New York. Paul Walters has been appointed assistant sales manager for California.

New CONSTRUCTION

	Current Projects		Cummulative 1939	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	.....	$1,085,000	$1,275,000
Middle Atlantic	$1,515,000	$2,476,000	4,800,000	11,933,00
South	1,000,000	893,000	8,733,000	9,115,000
Middle West	215,000	1,185,000	13,085,000	2,020,000
West of Mississippi	315,000	748,000	2,425,000	3,198,000
Far West	650,000	967,000	5,270,000	1,601,000
Canada	110,000	1,805,000	5,610,000	1,805,000
Total	$3,805,000	$8,074,000	$41,008,000	$30,947,000

PROPOSED WORK

Carbon Black Plant—C. E. Johnson, Ada, Okla., contemplates the construction of a carbon black plant in the gas fields near Ada. Estimated cost $40,000.

Cement Plant—Permanente Corp., H. J. Kaiser, Pres., 1522 Latham Sq. Bldg., Oakland, Calif., will receive bids until July 25 for constructing cement plant at Permanente, Calif.

Chemical Plant—Coastal Chemical Co., Harlingen, Tex., plans to rebuild part of plant and warehouse recently destroyed by fire. Work will be done by day labor and purchase and hire plan. (Correction—formerly published as Smith Chemical Co.)

Cork Factory—Crown Cork & Seal Co., Ltd., 320 Carlaw Ave., Toronto, Ont., Can., is having plans prepared by Marani Lawson & Morris, Archts., 46 Bloor St., W., Toronto, for the construction of an addition to its factory. Estimated cost $40,000.

Cotton Oil Plant—Choctaw Cotton Oil Co., Shawnee, Okla., plans to construct a cotton oil plant to replace the one recently destroyed by fire. C. Sparks, Shawnee, Engr.

Experimentation Plant—Johnson & Johnson, 500 George St., New Brunswick, N. J., plans to construct a new plant to be used for experimentation purposes. Estimated cost $600,000.

Factory—Union Carbon & Carbide Co., 30 East 42 St., New York, N. Y., plans to construct an addition to its plant at Charleston, W. Va. Estimated cost $1,000,000.

Gypsum Plant—National Gypsum Co., 190 Delaware Ave., Buffalo, N. Y., plans to construct an addition to its plant at East 148th St. and East River, New York, N. Y. D. F. Hunt, Ch. Engr. Estimated cost between $500,000 and $1,000,000.

Laboratory—Cleveland Pneumatic Tool Co., L. W. Greve, Pres., 3734 East 78th St., Cleveland, O., is having plans prepared by E. McGeorge, Archt., 9400 Quincy Ave., Cleveland, for the construction of a 1 story, 52x60 ft. laboratory. Estimated cost $40,000.

Leather Factory—Monarch Leather Co., 1127 West Division St., Chicago, Ill., is having plans prepared by I. S. Stern, Archt., 25 East Jackson Blvd., Chicago, for a 2 story addition to its plant on Division St Estimated cost $45,000.

Paint Factory—Anchor Paint Co., Ltd., D. M. Loucks, Mgr., 92 Norwich St., Guelph, Ont., Can., plans to construct a plant on Surrey St. Estimated cost $70,000.

Oil Refinery—Deep Rock Oil Co., Cushing, Okla., plans to construct recycling and cracking units. Universal Oil Products Co., 30 Rockefeller Plaza, New York, N. Y., Engrs. Estimated cost $75,000.

Oil Refinery—Shell Oil Co., Shell Bldg., San Francisco, Calif., plans to improve its refinery in distillation unit No 4. Estimated cost $650,000.

Rock Wool Factory—American Rock Wool Co., Wabash, Ind., plans to construct additions to its plant. Estimated cost including equipment $90,000.

Reduction Plant—O. H. Grissam & Associates, Longview, Tex., plans to construct an iron ore reduction plant using the natural gas process. Estimated cost $160,000.

Tannery—J. Greenbaum Tanning Co., 4763 North 32d St., Milwaukee, Wis., is having plans prepared by L. E. Peterson, Engr, 312 East Wisconsin Ave., Milwaukee, for the construction of a 2 story, 38x99 ft. addition to its tannery.

Zinc Plant—U. S. Steel Corp., 71 Bway., New York, N. Y., plans to construct a zinc plant at Gouverneur, N. Y.

CONTRACTS AWARDED

Aluminum Factory—Aluminum Co. of America, 2210 Harvard Ave., Cleveland, O., will construct a 1 story 60 x 150 ft. factory building. Work will be done by owner. Estimated cost $50,000.

Bulk Plant—Socony-Vacuum Oil Co., Lubrite Div., 4140 Lindell Blvd., St. Louis, Mo., and 26 Bway., New York, N. Y., has awarded the contract for a bulk plant at 128 Zepp St., St. Louis, Mo., including six 20,000 gal., three 230,000 gal. and one 840,000 gal. storage tanks, warehouse, etc., to B. C. Wagner, 4485 Olive St.; heating and process piping to American Power Piping Corp., Security Bldg., both contractors in St. Louis. Total estimated cost of project $250,000.

Glass Factory—Illinois Glass Co., Laurel St., Bridgeton, N. J., has awarded the contract for modernizing and constructing 57x186 ft. addition to its factory to Hughes-Foulkrod Co., 1505 Race St., Philadelphia, Pa. Estimated cost $94,000.

Laboratories—U. S. Department of Agriculture, Washington, D. C., has awarded the contract for Eastern Regional Research Laboratory at Wyndmoor, Montgomery Co., Pa., to Sordoni Construction Co., Wilkes Barre, Pa., at $842,000; Southern Regional Research Laboratory at New Orleans, La., to A. J. Rife Construction Co, P. O. Box 58, Dallas, Tex., at $843,000; Northern Research Laboratory at Peoria, Ill., to W. E. O'Neil Construction Co., 2751 North Clybourn St., Chicago, Ill., at $885,000; Western Regional Research Laboratory at Albany, Calif., to McDonald & Kahn Co., Ltd., Financial Center Bldg., San Francisco, at $817,000.

Cracking Tower Unit—Ben Franklin Refining Co., Ardmore, Okla., has awarded the contract for a two cycle cracking tower unit and Ethyl gasoline blending unit to Dresser Engineering Co., Philtower Bldg., Tulsa, Okla. Estimated cost $48,000.

Oil Refinery—Model Oil & Refining Co., c/o Tom Potter, Kilgore, Tex., plans to construct modern oil refinery. Work will be done by purchase and hire plan. Equipment will be purchased. Estimated cost $150,000.

Paint Factory—Montgomery, Ward & Co, 619 West Chicago Ave., Chicago, Ill., has awarded the contract for a 2 story, 104x160 ft. and a 4 story, 62x80 ft. paint factory at Chicago Heights, Ill., to B-W Construction Co., 307 North Michigan Ave., Chicago. Estimated cost $250,000.

Paper Mill—Berwin Paper Co., Dansville, N. Y., will construct a 41x113 ft. addition to its mill. Work will be done by day labor and separate contracts.

Paper Plant—Crown Willamette Paper Co., J. E. Hanny, Mill Mgr., Camas, Wash, has awarded the contract for a 4 story, 42x224 ft. wood bag plant and a 1 story, 44x120 ft. laboratory, to Drake, Wyman & Voss, Fenton Bldg., Portland, Ore.

Paper Plant—Palmetto Box Co., Greenville, S. C., has awarded the contract for a paper box plant to Potter & Shackleford, Inc., Greenville. Estimated cost $50,000.

Paper Plant—Scott Paper Co., Chester, Pa., has awarded the contract for design and construction of buildings and equipment to Stone & Webster, 90 Broad St., New York, N. Y Estimated cost $1,500,000.

Pottery Plant—Dominion Pottery Co, Ltd., Seventh Line, Oakville, Ont., Can., will construct a 1 story, 75x112 ft. plant by day labor. Estimated cost $40,000.

Sodium Products Plant—Salt Lake Sodium Products Co., D. C. Hunter, Gen. Mgr., Beneficial Life Bldg., Salt Lake City, Utah, will construct a plant with its own forces. Estimated cost $65,000.

Soy Bean Processing Plant—Albion Vegetable & Meal Co., Ltd., 197 Bay St., Toronto, Ont., Can., has awarded the contract for a soy bean processing plant on Talbot East St., St. Thomas, Ont., to Richardson Construction Co., 10 Adelaide St., E. Toronto. Estimated cost $40,000.

Soy Bean Mill—Swift & Co., U. S. Yards, Chicago, Ill., has awarded the contract for a soy bean mill at Des Moines, Ia., to James Stewart Corp., 343 South Dearborn St., Chicago, Ill. Estimated cost $300,000.

Sugar Refinery—Manitoba Sugar Co., Ltd., Royal Bank Bldg., Winnipeg, Man., Can., has awarded the contract for a beet sugar refinery to Carter-Halls, Aldinger Co., Ltd., Royal Bank Bldg., Winnipeg. Estimated cost $1,725,000.

Warehouse—Selberling Rubber Co., 120 11th St., San Francisco, Calif., has awarded the contract for a 1 story warehouse to Cahill Bros., 206 Sansome St., San Francisco. Estimated cost $45,000.

REFRIGERATION REQUIREMENTS BROADEN MARKET FOR HYDROFLUORIC ACID

FOLLOWING the general decline in business last year, domestic production of fluorspar underwent curtailment which took the form of reduced operating schedules at some mines and complete suspension at others. Total shipments from mines amounted to 80,403 short tons which represented a decline of more than 55 per cent from the 181,230 short tons shipped in 1937. The average price of sales also declined, the ton values in 1937 having been $20.23 and in 1938, $19.90. New Mexico, Nevada, and Arizona increased their shipments but the leading producing states, Kentucky, and Illinois, shipped out less than the 1937 amounts.

Consumption of fluorspar last year, however, held up better than did domestic shipments and amounted to 115,100 short tons which was a drop of less than 41 per cent from the 194,300 short tons consumed in 1937. The steel industry leads the consuming trades in importance by a wide margin and as steel output was unusually low last year, it is apparent why total fluorspar consumption was lowered so sharply. Reduced to comparative terms, the drop in consumption in the steel industry was approximately 47 per cent whereas all other consumers dropped their requirements by less than 22 per cent.

Of particular interest to the chemical industry has been the rising trend in the amount of fluorspar consigned to acid makers. A setback was encountered last year but this was to be expected in view of the general situation. In 1920 and prior years, the acid industry offered a good outlet for fluorspar but beginning with 1921 there was a marked downward trend in acid production and a corresponding fall in the movement of fluorspar to the chemical industry. This situation resulted from a slowing down in all important acid-consuming lines, including use as a cleansing agent for steel, an almost total cessation from brewing, and a reduced output of enamels and opalescent glass.

In more recent years, the trend was reversed and hydrofluoric acid began to regain its former status. Census figures report an output of 4,395,696 lb. for 1937 and 2,993,273 lb. for 1935, both totals representing 100 per cent acid. In 1925, production was 7,260,765 lb. but this figure refers to acid as reported, with no attempt to reduce the total to a 100 per cent basis.

Imports of fluorspar followed the general trend last year and dropped to 19,622 short tons compared with arrivals of 37,063 tons in the preceding year. The imported material goes principally to steel and acid makers with the latter having taken 9,492 tons in 1938 as against 9,900 tons in 1937, which was a very moderate decline especially in view of the fact that the unit price was $27.54 per ton in 1938 and $26.60 in 1937.

Germany and France which are the most important suppliers, lost heavily in the American trade last year, imports from France dropped almost 50 per cent and receipts from Germany fell from 14,501 tons in 1937 to 3,062 tons in 1938. In fact, Germany fell from its former top position to third ranking since Newfoundland shipped 4,752 tons into this country in 1938. The Union of South Africa and Tunisia assumed more importance in our import trade last year. Tunisia started fluorspar production in 1937.

Stocks of fluorspar at consumers plants at the close of last year declined to 71,800 tons from 90,100 tons at the beginning of the year. The reduction in stocks was general throughout the consuming industries with the exception of acid plants where stocks rose from 9,900 tons on Jan. 1 to 11,200 tons on Dec. 31, and at foundries where the excess supply remained unchanged at 800 tons.

Prices for fluorspar vary according to grades with the average for domestic material in 1938 running from $16.54 per short ton for foundry grade up to $26.63 per short ton for the quantities shipped to manufacturers of enamel. Acid grade averaged $24.84 per short ton. In each case, these averages represent a loss from the levels of the preceding year. Prices for imported fluorspar last year ranged from an average of $20.56 per short ton for steel-making grades to $27.54 per short ton for acid grades although a shipment of 11 tons for glass-making account was reported at $38 per short ton. Imported grades are quoted on a basis of selling price at tidewater, duty paid.

Fluorspar Consumed and in Stock in the United States, 1937 and 1938, by Industries, in Short Tons

(Partly estimated by Bureau of Mines)

	1937 Stocks at consumers' plants Dec. 31	1938 Stocks at consumers' plants Dec. 31
Basic open-hearth steel	71,400	55,000
Electric-furnace steel	1,300	1,000
Foundry	800	800
Ferro-alloys	700	400
Hydrofluoric acid	9,900	11,200
Enamel	1,500	900
Glass	3,200	1,600
Miscellaneous	1,300	900
	90,100	71,800

Domestic Consumption of Fluorspar By Industries, 1932–1938

Industry	1932	1933	1934	1935	1936	1937	1938
Basic open hearth steel	36,300	61,300	81,000	99,600	133,900	138,900	73,600
Electric furnace steel	2,100	3,400	4,300	5,400	6,900	7,500	4,000
Foundry	600	900	1,600	1,900	1,900	2,500	2,000
Ferro-alloys	200	300	500	700	800	1,200	800
Hydrofluoric acid	7,000	7,800	11,000	12,900	20,100	24,100	18,900
Enamel and bitrolite	2,400	3,200	3,500	4,900	5,400	5,900	4,000
Glass	6,700	7,000	7,700	11,000	11,600	11,600	10,500
Miscellaneous	700	700	1,000	1,000	1,800	2,600	1,300
	56,000	84,600	110,600	137,400	182,400	194,300	115,100

Fluorspar Shipped from Mines in the United States, 1937-1938, by Uses

Use	1937 Short tons	1937 Average value	1938 Short tons	1938 Average value
Steel	137,040	$18.51	51,991	$17.54
Foundry	2,566	18.42	2,041	16.54
Glass	12,697	26.79	8,702	25.78
Enamel	6,054	27.45	4,100	26.63
Hydrofluoric acid	17,879	26.93	11,484	24.84
Miscellaneous	4,538	19.01	1,297	20.03
Exported	456	19.94	788	11.50
	181,230	20.23	80,403	19.90

Imported Fluorspar Delivered to Consumers in the United States in 1937 and 1938

	1937 Short tons	1937 Selling price at tidewater, including duty Total	1937 Selling price at tidewater, including duty Average	1938 Short tons	1938 Selling price at tidewater, including duty Total	1938 Selling price at tidewater, including duty Average
Steel	24,266	$534,826	$22.04	10,205	$209,801	$20.56
Glass	166	6,205	37.38	11	418	38.00
Enamel	590	21,885	37.09	819	2,254	25.33
Hydrofluoric acid	9,900	263,336	26.60	9,492	261,399	27.54
Cement	48	1,073	22.35	.....	.....	.....
Miscellaneous	.....	.....	.....	66	1,546	23.42
	34,970	827,325	23.66	19,863	475,418	23.93

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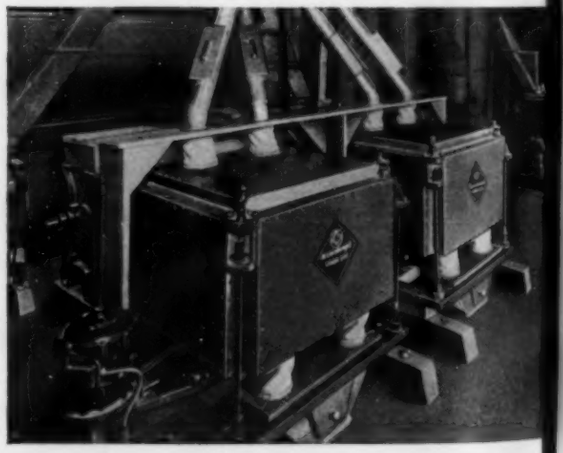

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